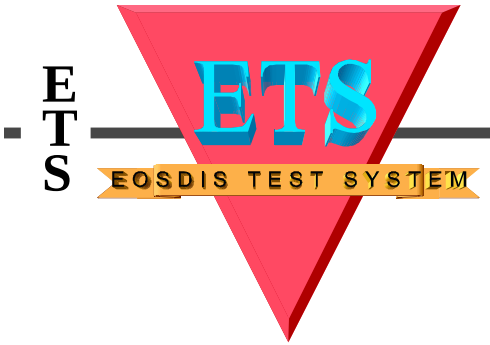




# ETS Detailed Design Review Management Presentation

## March 8, 1996

# AGENDA

ETS

- Review Purpose
- Management Information
- Significant Changes Since Initial Design Review
- System Overview
- ETS Operations Scenarios
- MPS Detailed Design Overview
- HRS Detailed Design Overview
- LRS Detailed Design Overview
- Development and Test Environment
- Integration Test Approach
- System Test Approach
- Acceptance Testing Approach
- Training Approach
- Transition to Operations
- RID/Comment Process

# Review Purpose

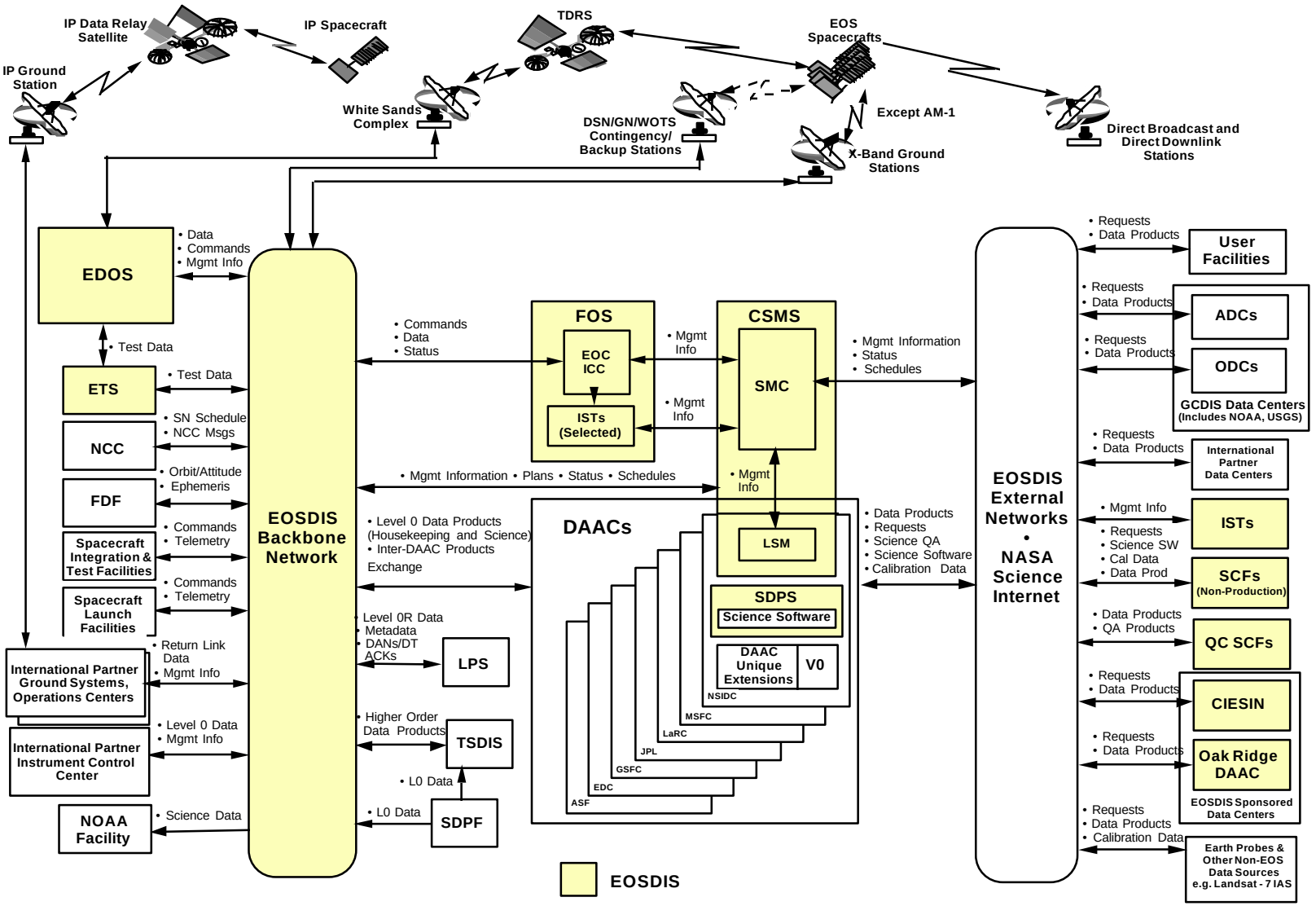
# Review Purpose

ETS

- **Show that final design meets all requirements allocated to the ETS**
- **Provide ESDIS insight into ETS development process**
- **Provide ETS users with more information about ETS capabilities and usability**
- **Provide for Project/user input to the ETS design**

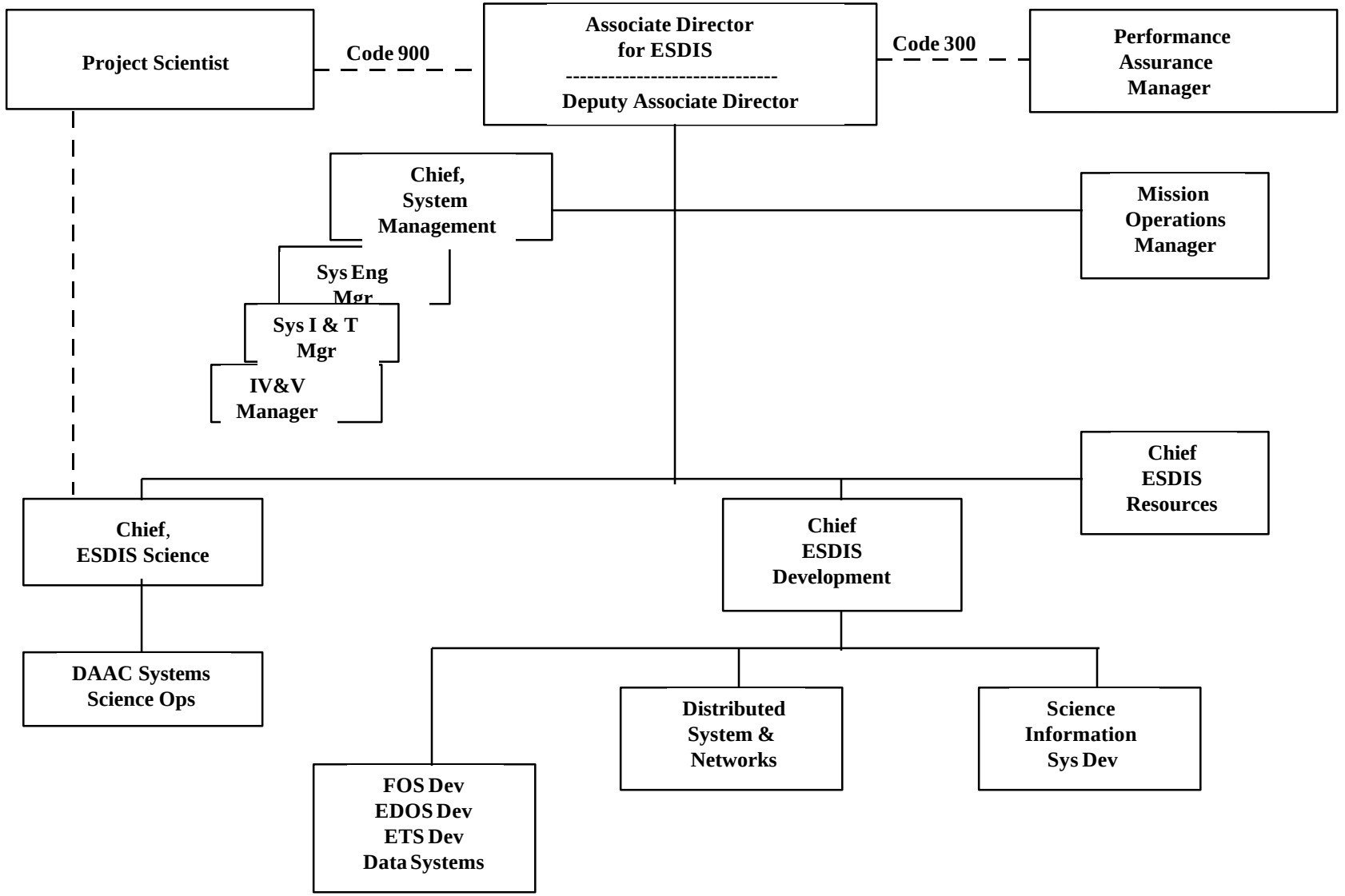
# Management Information

# EOS Ground System

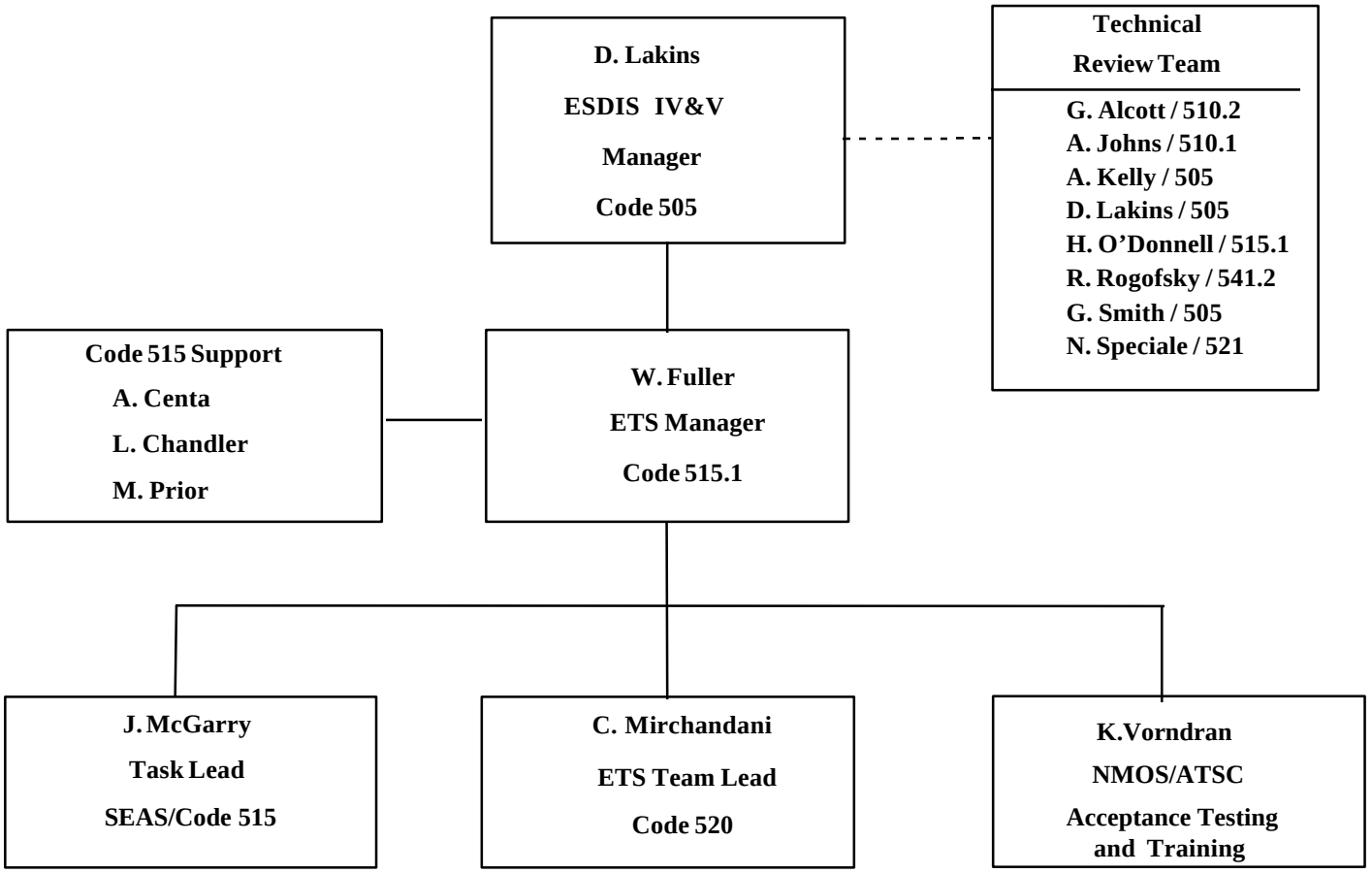


# ESDIS Project Organization





# ETS Organization Chart



# Key Milestones

ETS

- **MPS**
  - MPS Build 1 Demonstration - 4/12/96
  - MPS Engineering Model @ SOC - 8/1/96
- **HRS**
  - Build 1 Demonstration - 5/8/96
    - Includes demonstration of SCTGEN capabilities
- **LRS**
  - LRS Build 1 Demonstration - 5/29/96
  - LRS Engineering Model @ EOC - 9/3/96
- **SCTGEN**
  - Build 1 - 4/2/96
  - Build 2 - 7/1/96
- **ETS (MPS/LRS/HRS)**
  - Begin Acceptance Testing - 9/30/96
  - ESDIS Project Delivery - 12/2/96

**NOTE: Detailed schedule provided as separate handout at review**

# Development Status

ETS

- **Joint ESDIS/ETS Action Item list status**
  - Action Item list provided as separate handout [2 Open/54 Recommended for closure/2 Closed]
  - A meeting to approve closure on items in the action item list will be scheduled in March
- **ETS F&PR**
  - Approved by 510 CCB
  - ETS F&PR will be distributed on ETS homepage
  - Preparing for submission to 505 CCB
- **Reviews Held Since the ETS System Design Review (May 1995)**
  - ETS Requirements Specification reviews held October 10 and 12, 1995
  - ETS Initial Design Walk-Through reviews held November 30 and December 13, 1995
  - ETS Final Design Walk-Through reviews held February 2 and 29, 1996
    - Minutes and action item list for MPS/LRS review distributed February 29
    - Minutes and action item list for HRS/SCTGEN will be distributed by March 15
    - Revised detailed design specification will be distributed on ETS homepage
- **ETS homepage**
  - URL: http://esdis.gsfc.nasa.gov/ivv/ets.html
  - Homepage documents will be provided in Adobe Portable Document Format (PDF)

# Significant Changes Since Initial Design Review

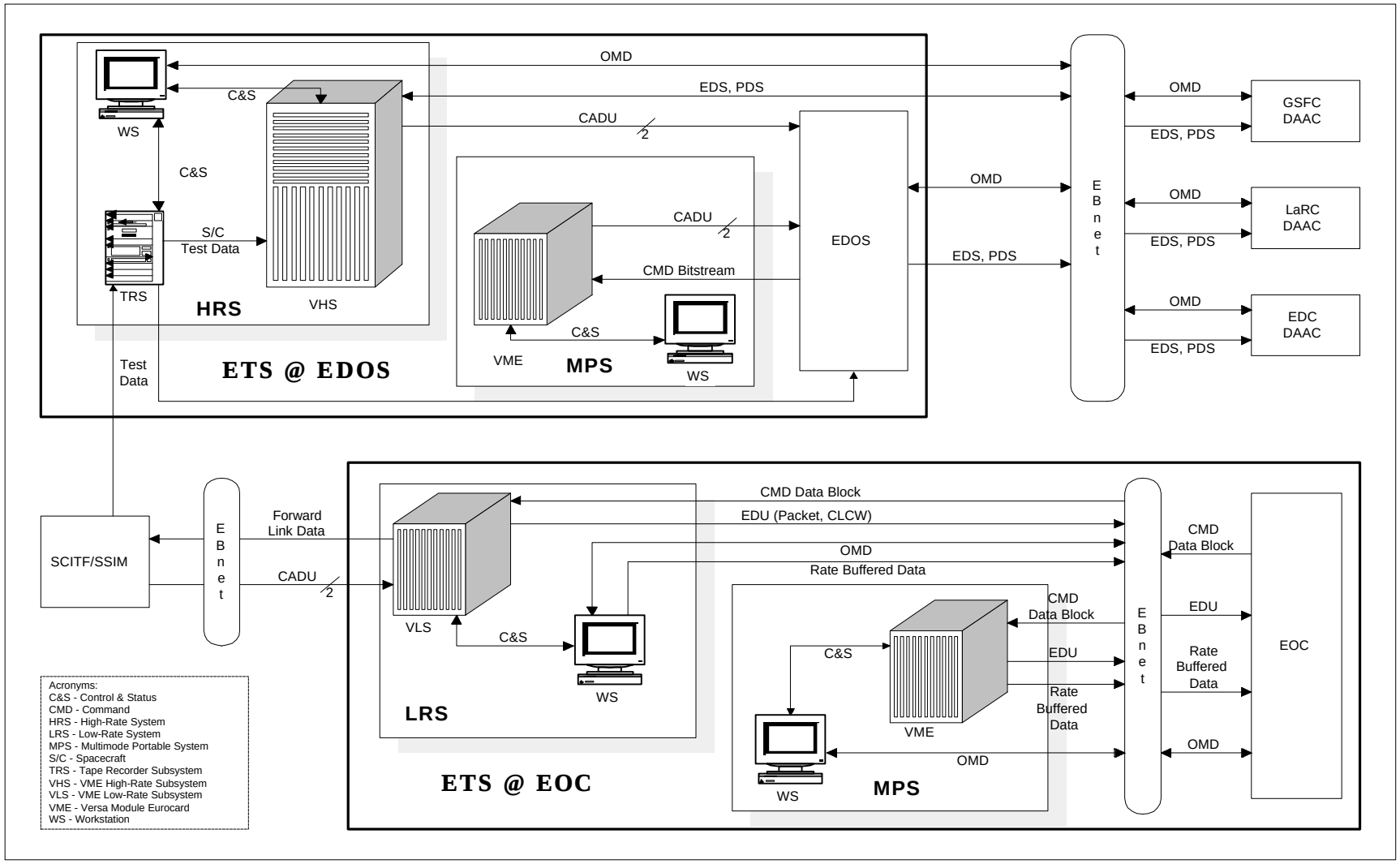
# Significant Changes Since Initial Design Review

ETS

- **ESDIS Reshape impact on ETS resulted in decision to move ETS HRS and MPS from EDOS/WSC to EDOS/GSFC**
  - Common equipment needed for ETS high-rate data generation and data set simulation precludes distributing ETS components between WSC and GSFC
  - Serial high-rate data streams will be transmitted into EDOS/GSFC using ETS HRS
  - ETS simulated science data and user-provided spacecraft data will be transferred to EDOS tapes at EDOS/GSFC, mailed to WSC, and played back into EDOS/WSC using EDOS recorders
  - ETS MPS will transmit serial low-rate data streams into EDOS/GSFC and will receive the EDOS transmitted forward link data
- **ETS sensitivity level will change from Level 1 to Level 2 to comply with ESDIS security policy**
  - Requires changes to ETS security requirements in Level 2 and Level 3 requirements documents
  - ETS will need to comply with applicable provisions in ECS Security Plan and NASA AIS Handbook (NHB2410.9A)
  - ETS system level requirements (Level 4) will be added, following an assessment of applicable documents and approval by the ESDIS Project security organization
- **Two Level 3 requirement changes made to ETS F&PR**
  - Requirement added (3.1.24) to provide the capability to encapsulate user-provided AM-1 science packets and raw sensor data in CCSDS CADUs for transmission
  - ETS facility requirement for power (4.1.3) changed from 10Kw to 20Kw, based on a recent reevaluation of ETS power requirements

# System Overview

# System Architecture



# ETS Simulators

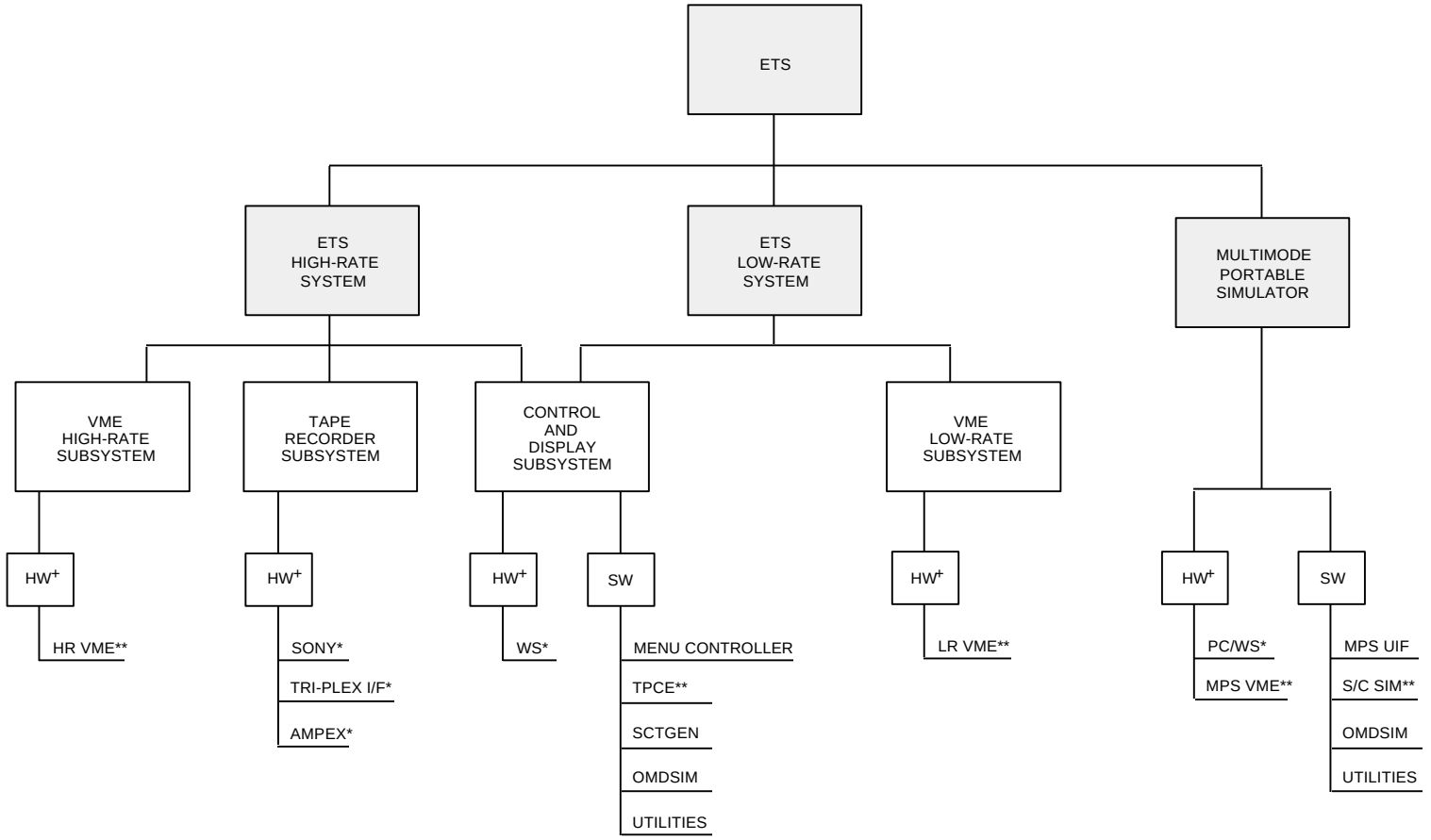
- **Multimode Portable Simulator (MPS) -- low fidelity spacecraft simulator to support testing of forward-link and non-science return-link processing**
  - Generate and transmit low-rate spacecraft data as CADUs (for input to EDOS), as CADUs in Nascom 4800-bit blocks (for input to EBnet as if from a contingency site), and as packets in EDUs (for input to EOC)
  - Receive and verify spacecraft commands in CLTU bitstream, 4800-bit blocks, or command data blocks
  - Use AM-1 project data base (PDB) to generate telemetry and verify commands
  - Simulate EDOS data formats, rate buffered data file transfers to EOC, EDU headers, and OMDs
- **High-Rate System (HRS) -- EOSDIS return-link science data processing and interface test tool**
  - Simulate TGT transmission of up to two 150 Mbps data streams for input to EDOS
  - Simulate EDOS transmission of data sets to test interface with DAACs
  - Simulate DAAC reception of data sets to test interface with EDOS
  - Process SCITF-recorded spacecraft data to generate EDOS compatible data sets
- **Low-Rate System (LRS) -- functional EDOS interface between the EOC and either the SCITF or SSIM**
  - Perform EDOS return-link processing on low-rate CADUs received from SCITF or SSIM
    - Perform frame synchronization, Reed-Solomon decoding and error correction, packet reassembly, CLCW extraction, EDU construction, and EDU transmission to EOC
    - Store low-rate playback data H/K EDUs and transfer as rate-buffered data files to EOC
  - Perform EDOS forward-link processing on command data blocks received from EOC
    - Remove EDOS ground message header and forward CLTUs and clock to SCITF or SSIM
  - Generate and transmit OMD messages to EOC reflecting data processed

# External Interfaces

ETS

- **For data flows between operational elements that ETS will be used to simulate or test, ETS will comply with those data formats and protocols documented in the controlling ICDs, including**
  - EDOS-EGS ICD
  - TGT-EDOS ICD
  - SSIM-EOC ICD
- **ETS specific ICDs under development**
  - EBnet-ETS ICD being developed by EBnet (Review, dated February 1996)
  - EDOS-ETS ICD being developed by EDOS (Final, dated December 1995)
- **Plan to establish ICD or DFCD to document the format of spacecraft data tapes from Lockheed Martin**

# System Configuration Item (CI) Architecture




HW = HARDWARE
SW = SOFTWARE
S/C = SPACECRAFT
* COTS
** REUSE OF EXISTING DESIGN/PRODUCTS
+ INCLUDES EMBEDDED SW

# ETS Operations Scenarios

# Typical User Activities (1 of 2)

ETS

## HRS

### Pretest Activities

- Develop activity schedule to automate test session
- Create configuration setup files
- If new test data required, prepare test data using SCTGEN or user-provided data
- If test data tape required for playback at EDOS/WSC, transmit ETS data to EDOS data capture system for recording and tape generation

### Test Activities

- If required for test, transmit test data, including SCTGEN-created test data
- Monitor system status, data quality, and accounting displays
- Enable/disable data logging options

### Posttest Activities

- View final summary status
- If required for test, compare or verify actual received data with SCTGEN-produced expected results
- View system activity log
- Generate summary reports on user request

## SCTGEN

### Pretest Activities

- Design data generation specification
- Generate expected results from specification
- Generate test data
- Verify test data
- Log test data file name, descriptors, and storage location

# Typical User Activities (2 of 2)

ETS

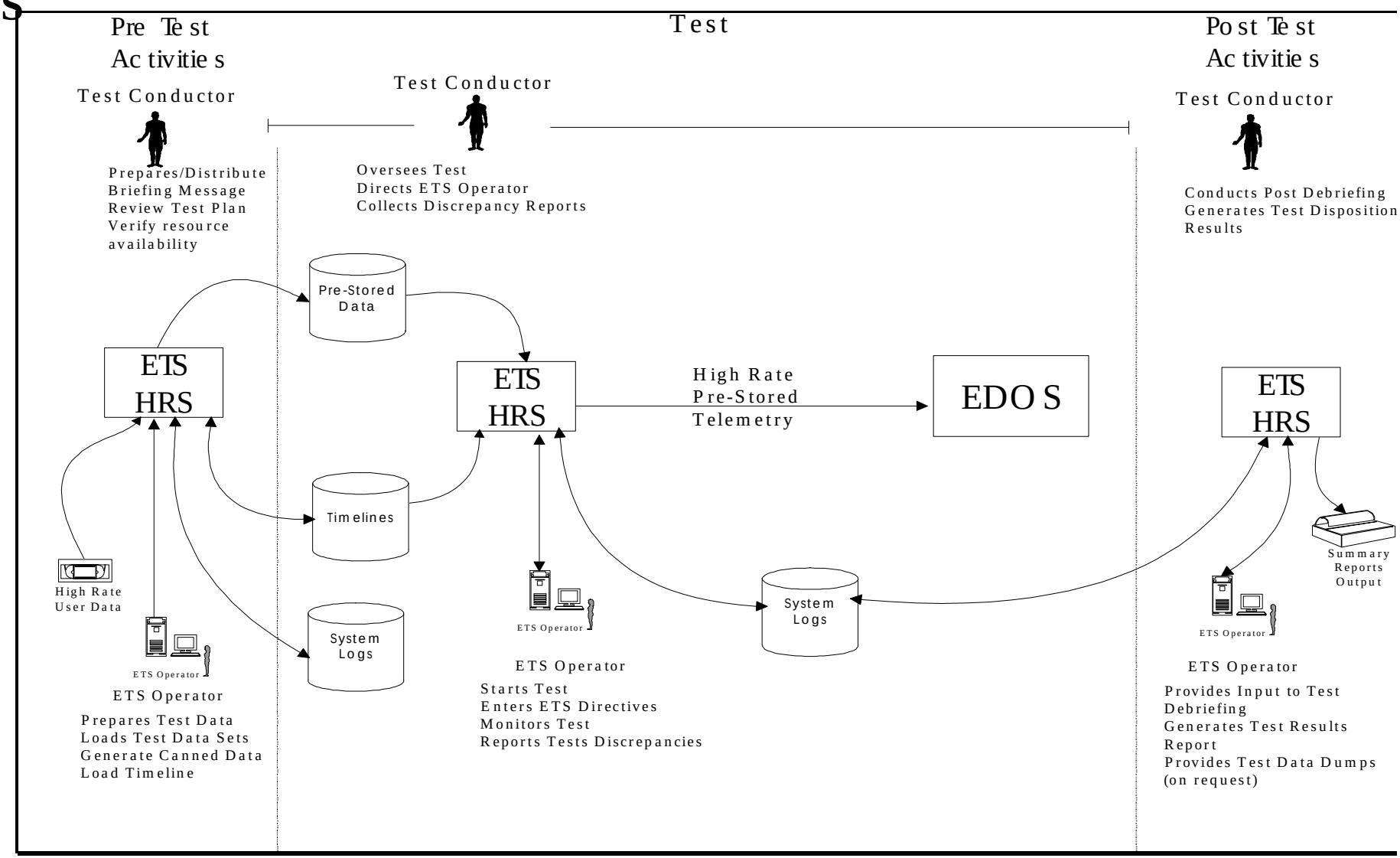
| LRS | MPS |
|---|---|
| **Pretest Activities** | |
| • Create configuration setup files, if different than standard configuration | • Modify CMD and TLM files when new PDB received<br>• Create test scenario file to control data contents, formats, and rates, for example<br>• Load external data file of packets for interleaving<br>• Generate canned OMD messages |
| **Test Activities** | |
| • Select source of external S/C data (SCITF or SSIM)<br>• Monitor data quality and accounting displays<br>• Enable/disable CODA generation and transmission<br>• Enable/disable data logging options | • Control and monitor system functions<br>• Monitor data quality and accounting displays<br>• Enable/disable CODA simulation and transmission<br>• Enable/disable data logging options<br>• Control scenario file execution<br>• Inject errors and adjust TLM parameter values and modeling associations |
| **Posttest Activities** | |
| • View final summary status<br>• Delog stored data<br>• View system activity log<br>• Generate summary reports on user request | • View final summary status<br>• Delog stored data<br>• View system activity log<br>• Generate summary reports on user request |

# ETS Test Configurations

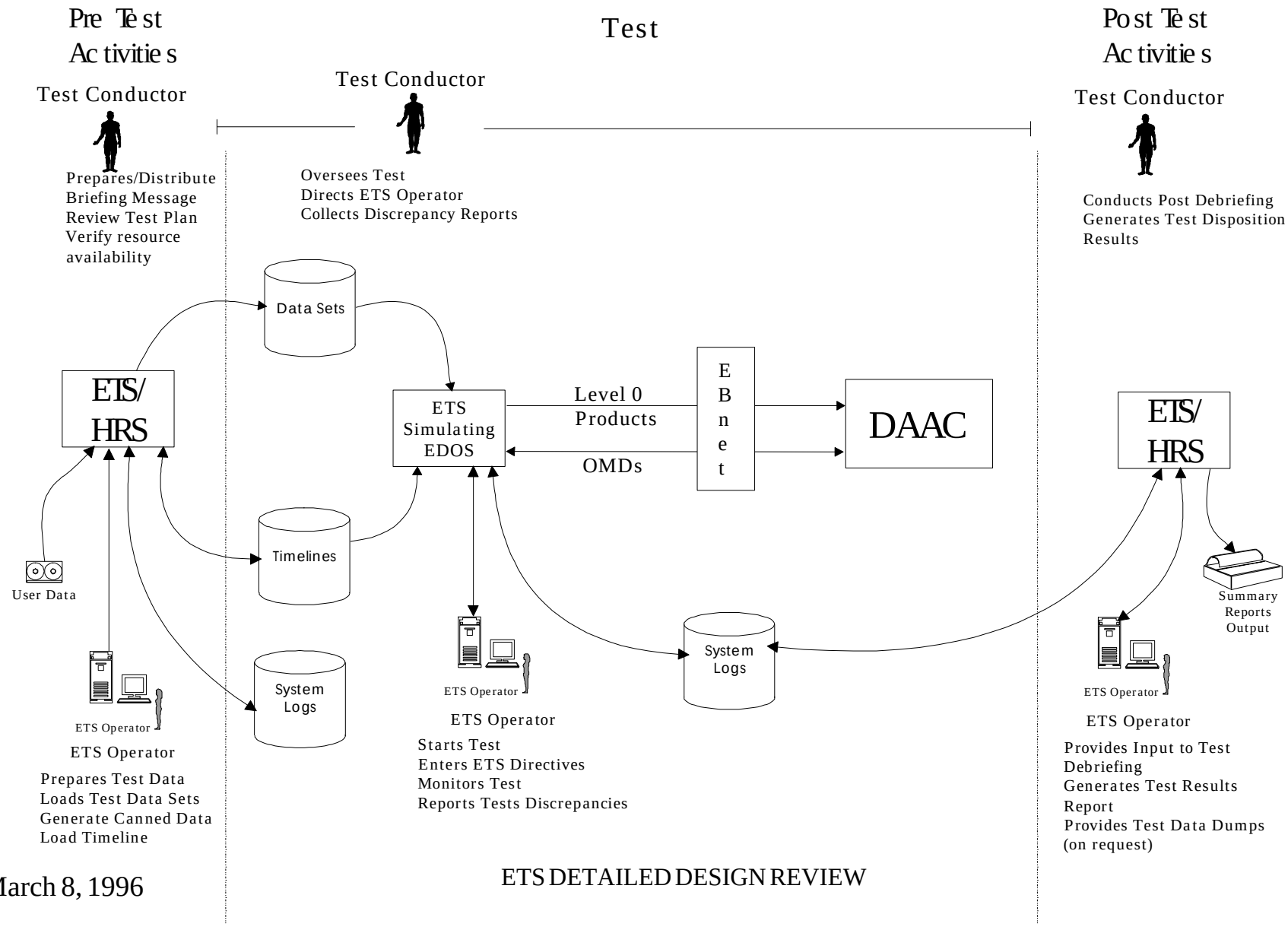
ETS

| Test Configuration | ETS Unit |
|---|---|
| 1. Provide high-rate spacecraft data simulating the TDRSS Ground Terminal (TGT) interface to EDOS | HRS |
| 2. Simulate and transmit EDOS data sets to a DAAC | HRS |
| 3. Simulate the front-end of a DAAC and receive EDOS data sets | HRS |
| 4. Provide low-rate spacecraft simulations<br>· Support EOSDIS normal and contingency-mode operations when EDOS is available for forward- and return-link processing<br>· Support tests with the EOC when EDOS is not available | MPS |
| 5. Provide low-rate EDOS functions for EOC to interface with the EOS AM-1 spacecraft integration and test facility (SCITF) and the EOS AM-1 spacecraft simulator (SSIM) | LRS |

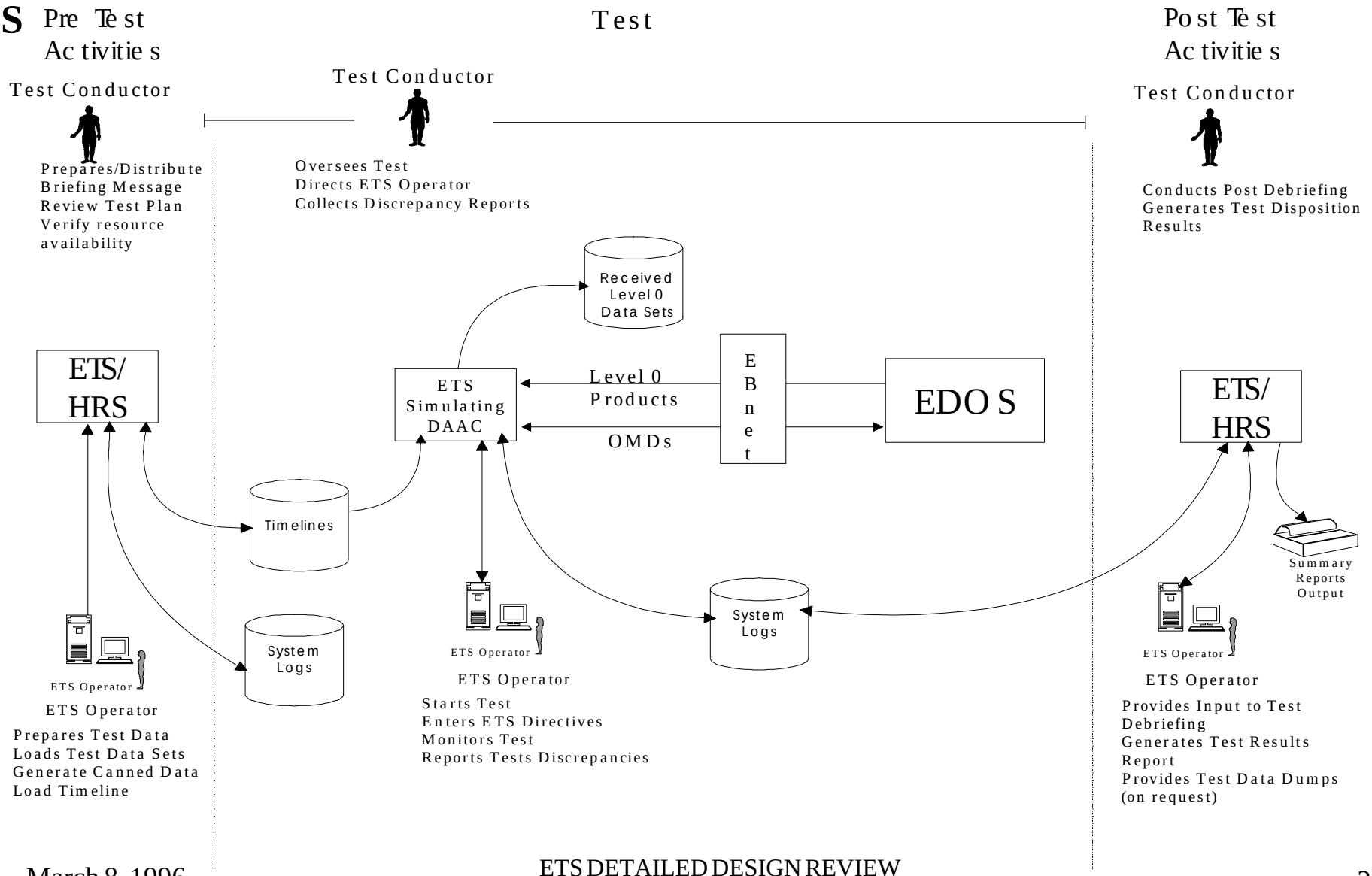
# ETS Test Configuration 1: High-Rate Interface Scenario



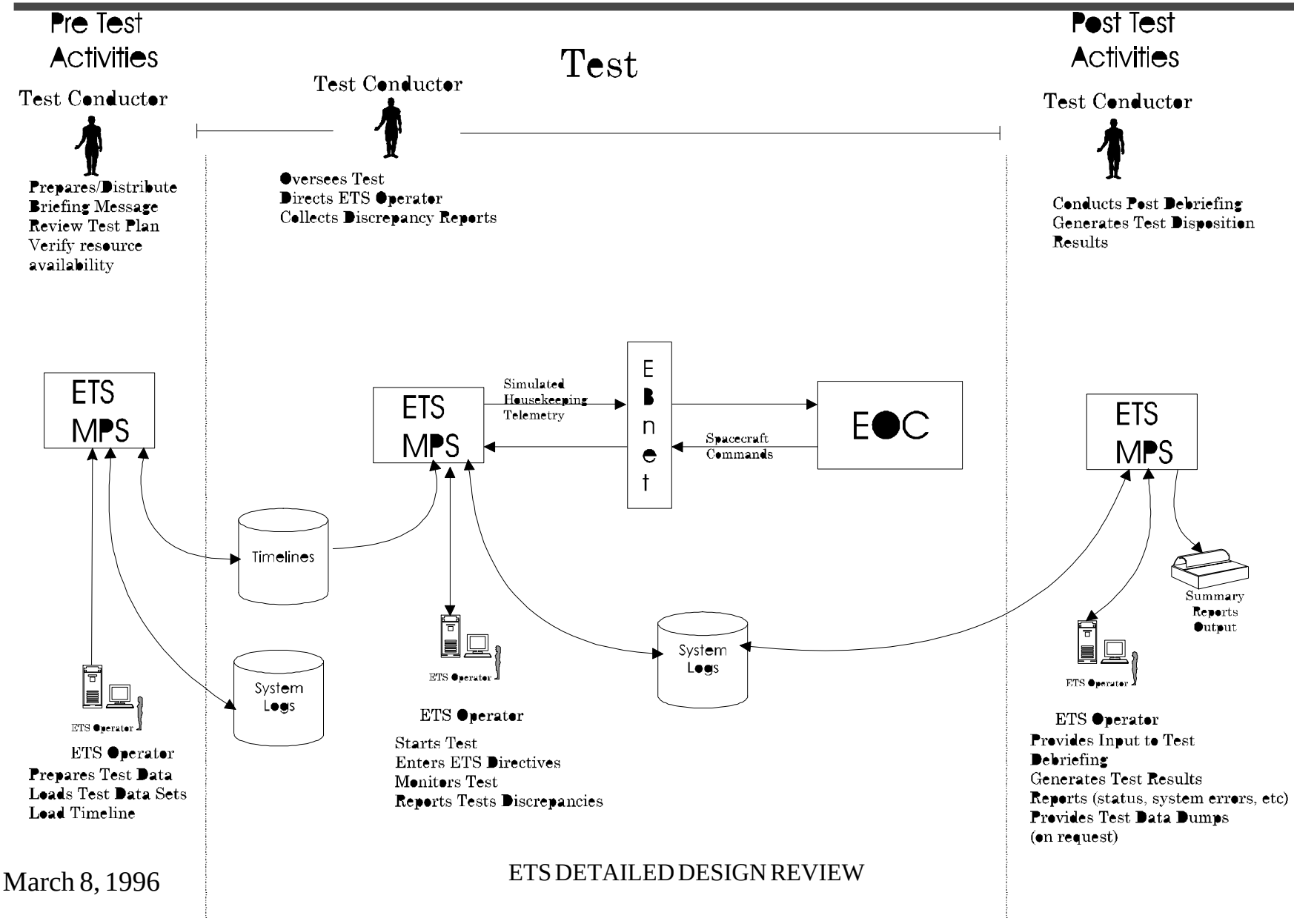
# ETS Test Configuration 2: DAAC-EDOS Scenario



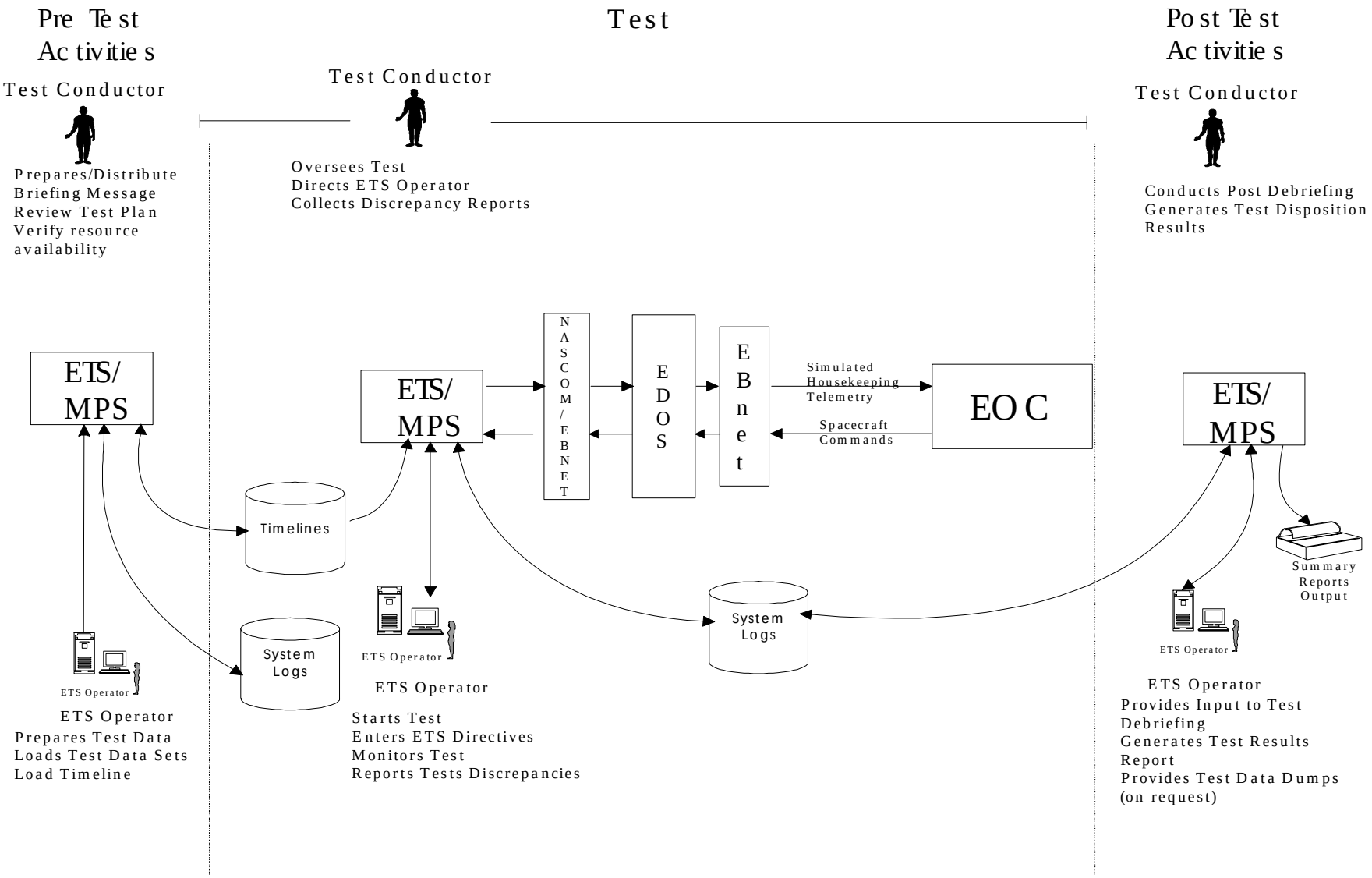
# ETS Test Configuration 3: EDOS-DAAC Scenario



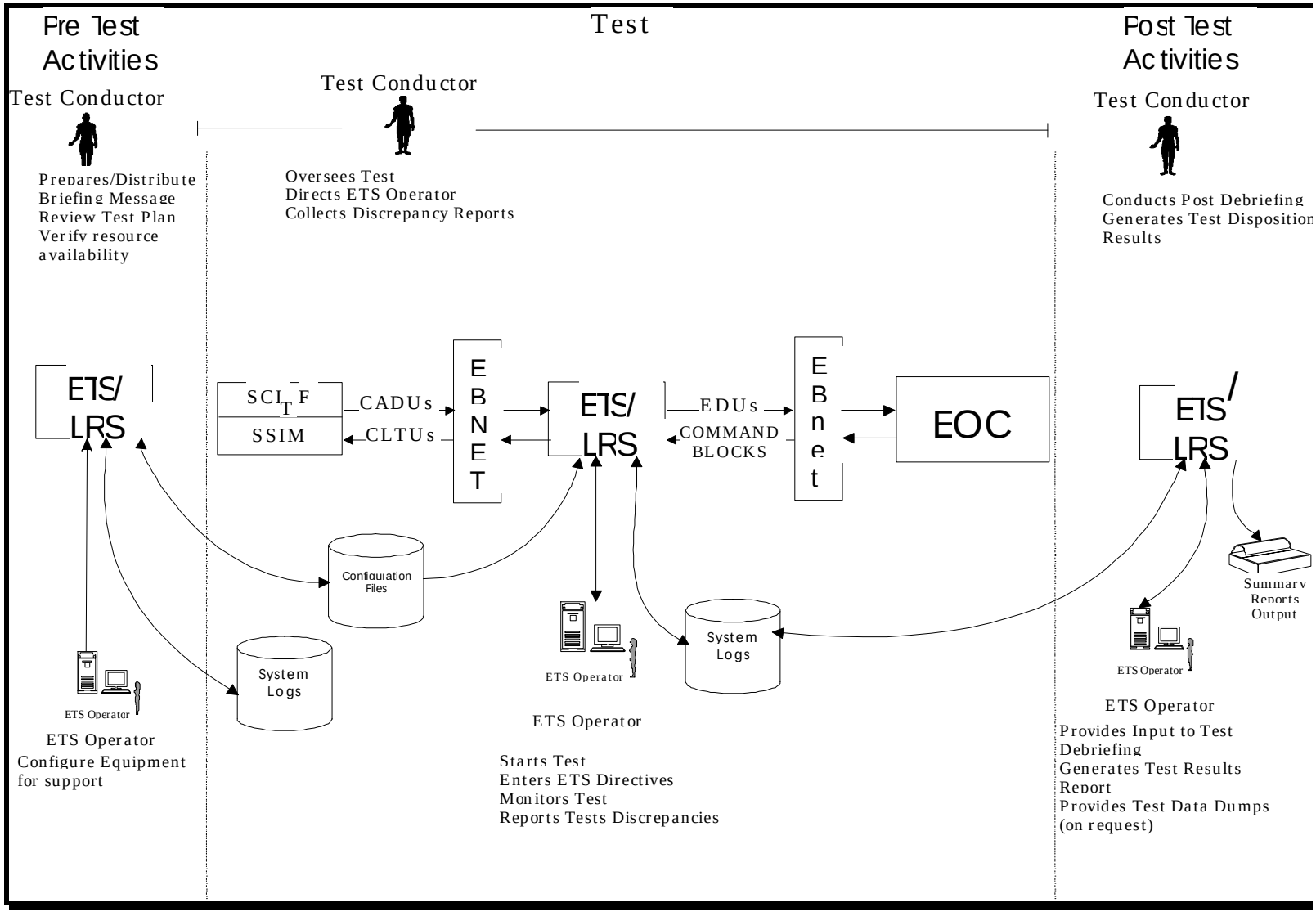
# ETS Test Configuration 4: MPS-EOC Scenario



# ETS Test Configuration 4: MPS-Contingency Site-EDOS Scenario



# ETS Test Configuration 5: SCITF/SSIM-EOC Interface

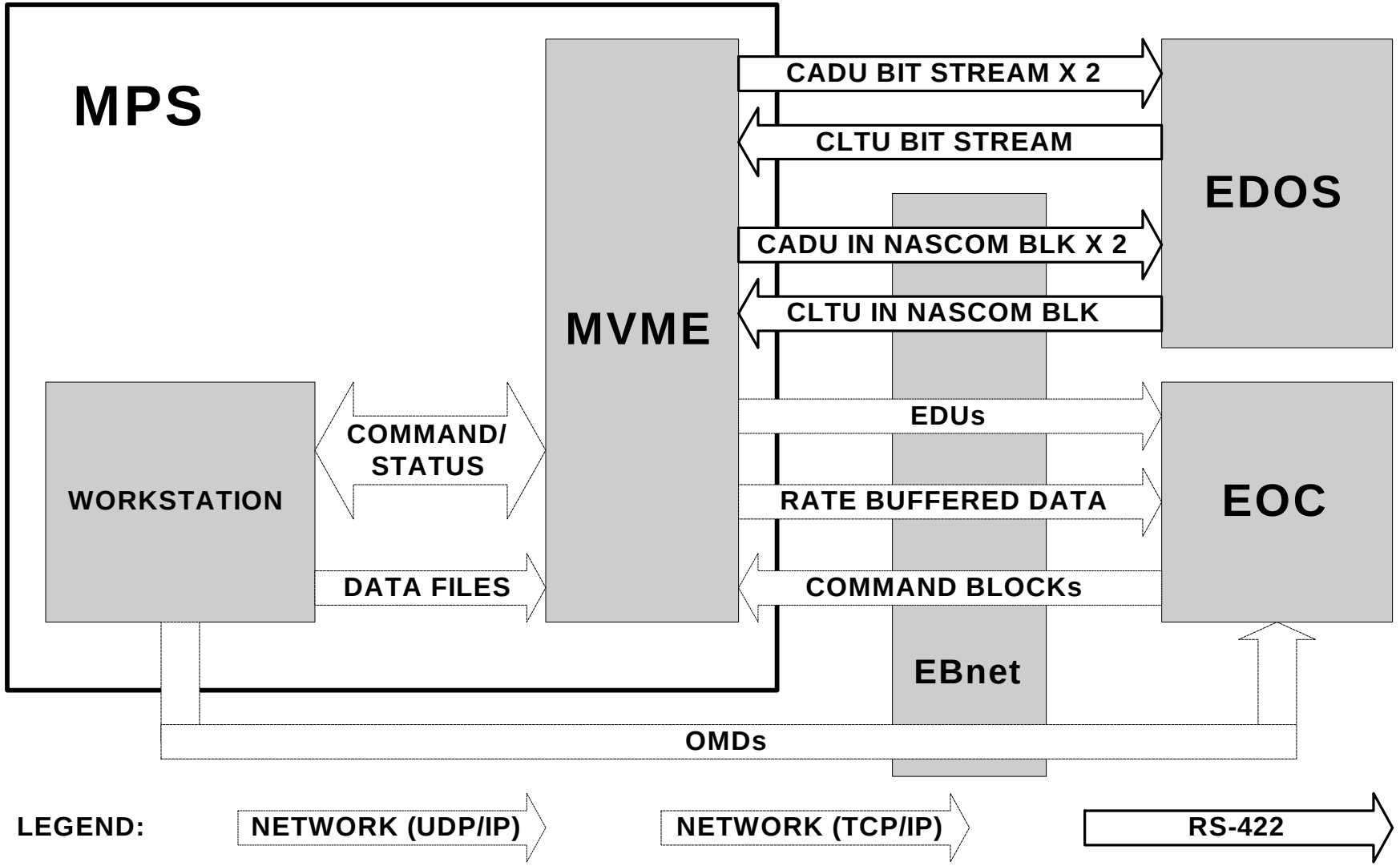


# MPS Detailed Design Overview

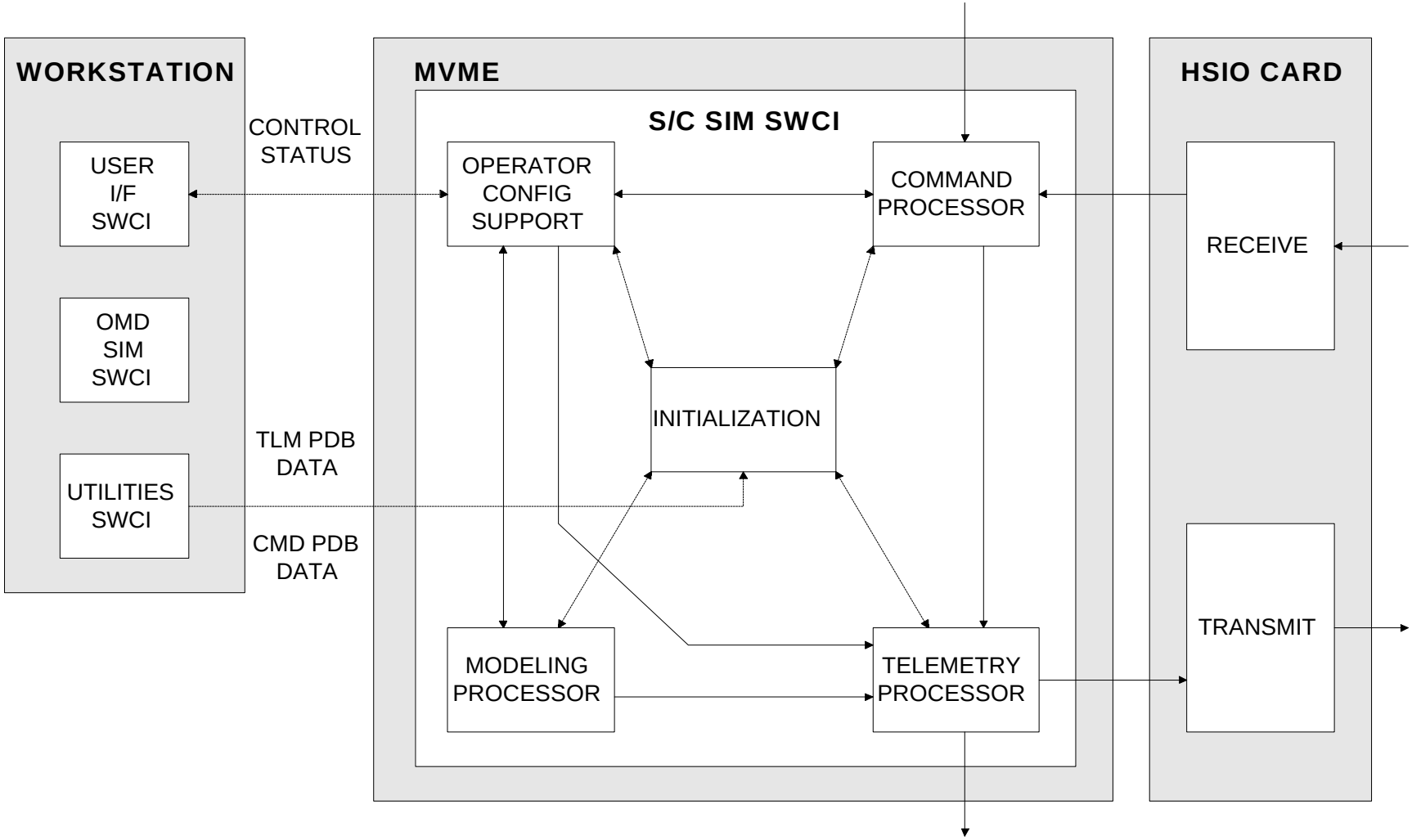
# MPS Major Functions

- **Simulate S-band telemetry formats and receive spacecraft commands to test interface with EDOS**
- **Simulate low-rate telemetry formats and receive spacecraft commands in Nascom blocks to test contingency network interfaces to EDOS through EBnet**
- **Simulate and transmit low-rate telemetry in EDOS formats to the EOC and receive spacecraft commands from the EOC as command data blocks**
- **Use AM-1 Project Data Base files (PDB) for telemetry generation and command verification**
- **Provide limited telemetry responses to valid spacecraft commands**
- **Provide Operations Management Data (OMD) simulation capabilities for subset of EDOS and EOC OMD**

# MPS System Interface Diagram



# MPS Functional Overview



# MPS Functional Overview

ETS

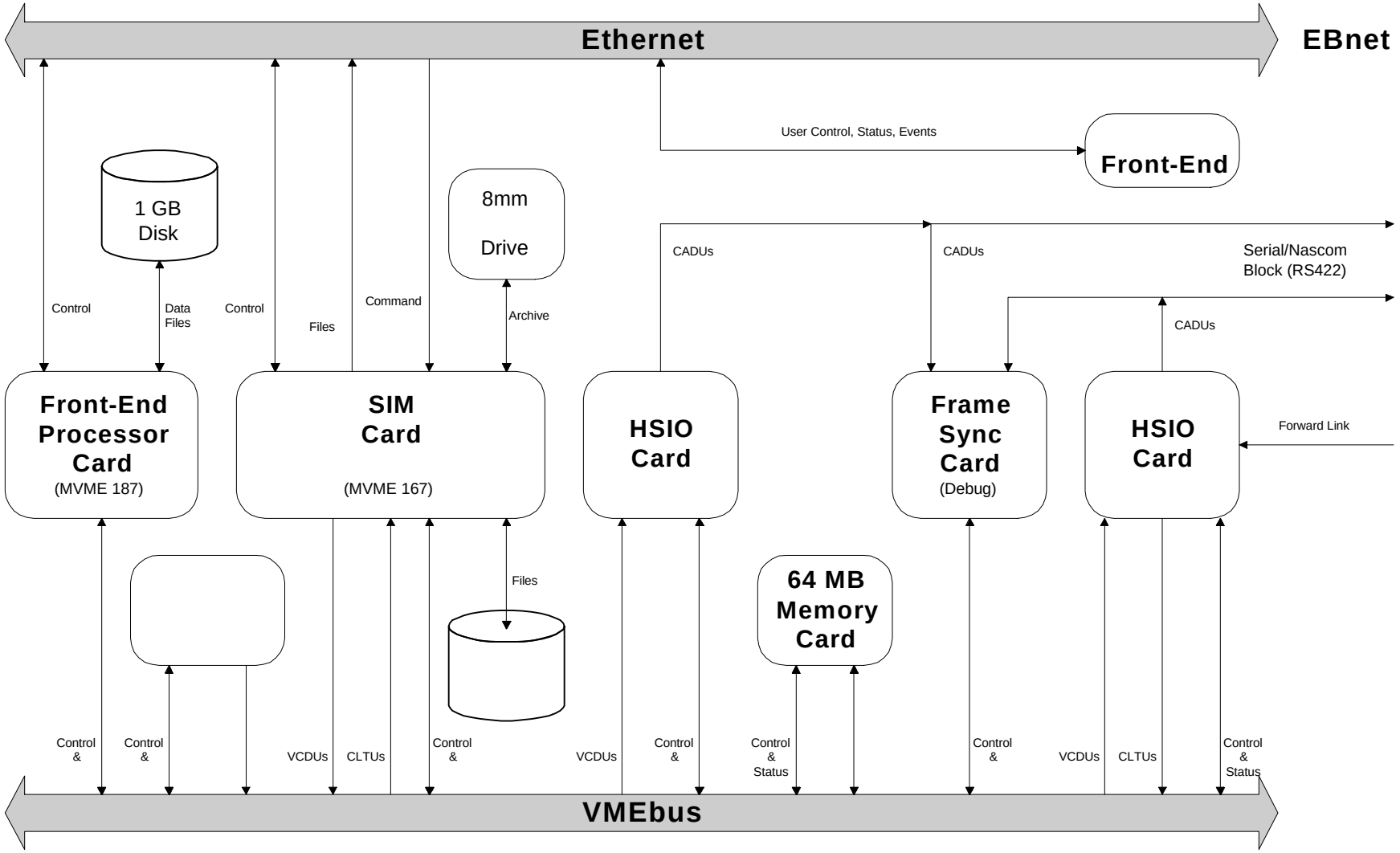
- **USER I/F SWCI**
  - Provide for comprehensive operator control and status monitoring capabilities
- **UTILITIES SWCI**
  - Prepare PDB information
- **OMDSIM SWCI (Rehost from LRS)**
  - Primarily provide for simulation of CODA messages
  - Allow operator to create and transmit OMDs to EOC
  - Allow operator to receive and log OMDs
- **S/C SIM SWCI Components**
  - Configuration Support
  - Initialization
  - Telecommand
  - Telemetry
  - Modeling

# MPS S/C Sim SWCI Functional Overview

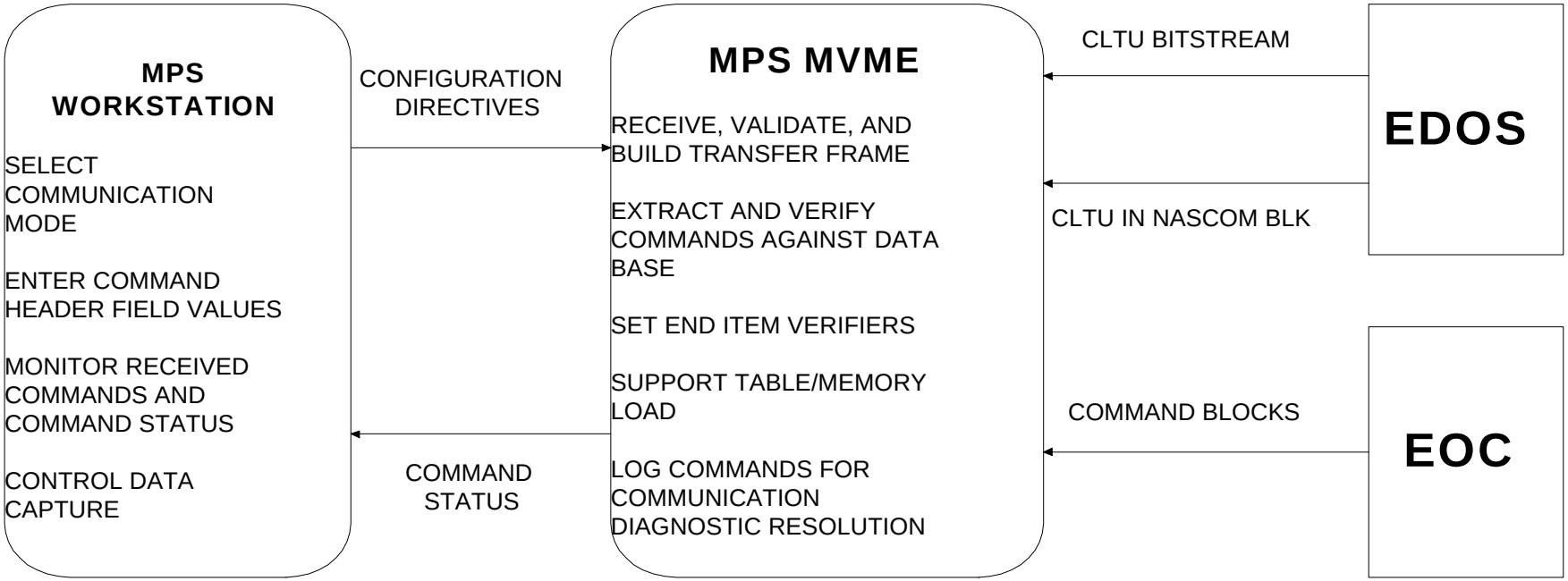
ETS

- **CONFIGURATION SUPPORT COMPONENT**
  - Provide operator control and status capabilities
  - Accept and use simulation timelines
  - Log and delog user directives and event messages
  - Insert operational anomalies
- **INITIALIZATION COMPONENT**
  - Make PDB, model tables, and HRS H/K data available to Command, Telemetry, and Model tasks
- **TELECOMMAND COMPONENT**
  - Receive commands as either UDP blocks (from EOC) or CLTUs (from EDOS)
  - Validate commands using CCSDS COP-1 protocol
  - Update telemetry parameters to simulate command execution
  - Support memory loads and dumps
- **TELEMETRY COMPONENT**
  - Support all AM-1 non-science rates and formats
  - Format telemetry using CCSDS AOS standards
  - Emulate solid-state recorder pointers (in telemetry values)
- **MODELING COMPONENT**
  - Provide for time driven scenario files
  - Provide for table driven and algorithm driven modeling of parameters

# MPS System Design Block Diagram

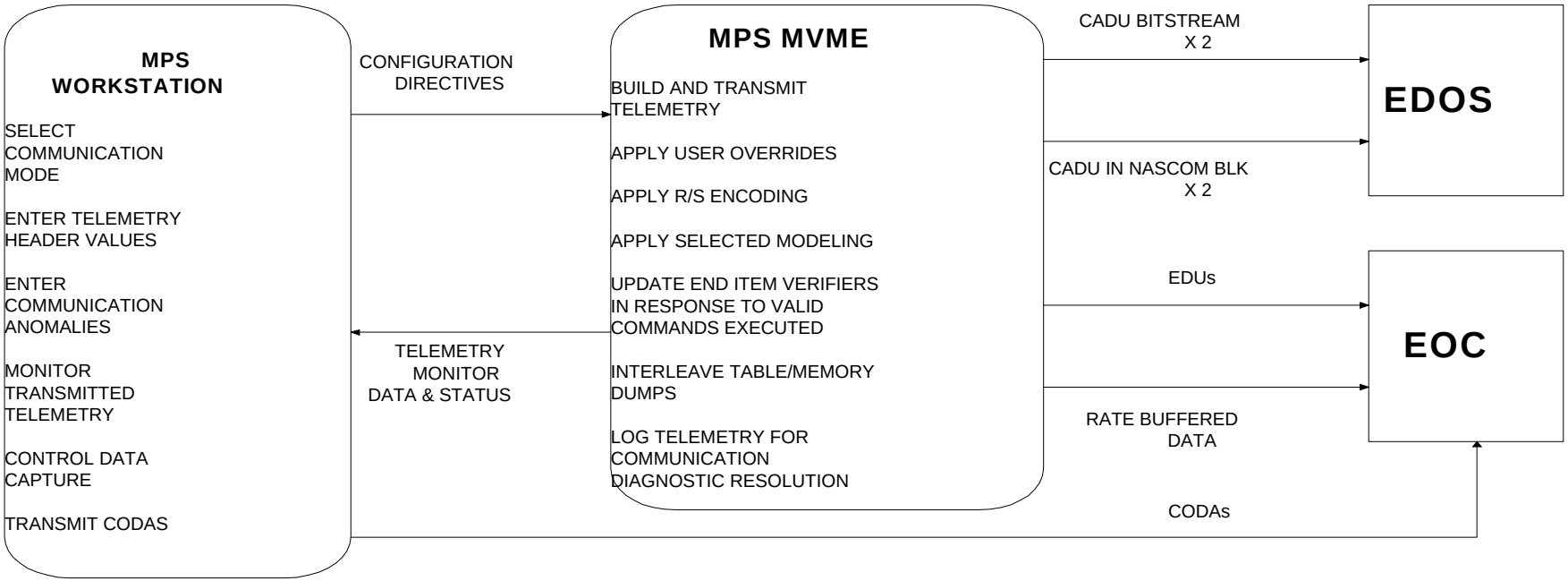


# MPS Uplink Processing Scenario




- **Load latest version of AM-1 PDB (invoke PDB Utility from MPS Menu Controller)**
- **Invoke/Start MPS from ETS Menu Controller**
- **Configure MPS Command ports for test**
- **Monitor processing/status of received commands**

# MPS Return Link Processing Scenario




- **Load latest version of AM-1 PDB (invoke PDB Utility from MPS Menu Controller)**
- **Invoke/Start MPS from ETS Menu Controller**
- **Configure MPS Telemetry ports for test**
- **Monitor transmissions/status of transmitted telemetry**
- **Introduce communication/data anomalies**
- **Apply modeling functions to selected telemetry parameters**

# MPS Size Estimates

| Component | DSI | Reuse % | Source |
|---|---|---|---|
| User I/F | 4700 | 0 | |
| Utilities | 2200 | 60 | SOC Baseline |
| OMDSIM | 5000 | 90 | LRS |
| I/F Support | 1240 | 0 | |
| Initialization | 4500 | 90 | SOC Baseline |
| Telecommand | 12100 | 65 | SOC Baseline |
| Telemetry | 18500 | 45 | SOC Baseline |
| Modeling | 5480 | 90 | SOC Baseline |
| Total | 53600 | | = 14820 wDSI |

# MPS Build Plans

ETS

- **April 1996 Capabilities (MPS Build 1)**
  - User Interface (GN/SN) 2000 wDSI
  - Timekeeping 280 wDSI
  - PDB Extractor 100 wDSI
  - GN/SN CMD/TLM Support 2680 wDSI
  - Initialization 500 wDSI
  - Interface Support S/W 500 wDSI

  **MPS Build 1 = 6060 wDSI**
- **August 1996 Capabilities (MPS Release 1)**
  - User Interface (EDOS Sim) 2700 wDSI
  - OMDSIM 500 wDSI
  - CMD/TLM/System Logging 700 wDSI
  - Memory Load/Dumps 800 wDSI
  - I/F Support 740 wDSI
  - EDU Generation (All modes) 600 wDSI
  - Scenario File Processing 200 wDSI
  - Rate Buffer File Generation 100 wDSI
  - EDU Generation (Nominal) 600 wDSI
  - UDP CMD Block Processing 1220 wDSI
  - HRS H/K File Processing 300 wDSI
  - Modeling 300 wDSI

  **MPS Release 1 = 8760 + 6060 = 14820 wDSI**

# MPS Level 4 Requirement Modifications

ETS

- **The following are the modified Modeling requirements:**
  - V2-31110-15: MPS shall provide modeling files which define static, table, or algorithm files based on telemetry mnemonic.
  - V2-32120-15: MPS shall set initial telemetry parameter values as identified in a previously defined telemetry initialization table.
  - V2-33200-02: MPS shall provide the operator with the capability to access model tables, giving values for each AM-1 telemetry parameter at specific points in time.
  - V2-33200-03: MPS shall provide the operator with the capability to access model functions and coefficients.

- **The following requirement has been removed due to lack of detail:**
  - V2-32310-12: MPS shall be capable of transmitting command echo blocks (TBD).

- **The following Solid State Recorder (SSR) requirement has been removed due to lack of need:**
  - V2-32120-16: MPS shall execute telemetry directives that control the MPS solid state recorders.

- **The following SSR requirement has been expanded to specify exactly what will be included in the playback stream. This requirement applies to the MPS running in the spacecraft simulation mode.**
  - V2-32440-12: MPS shall simulate playback of recorded telemetry data by generating and transmitting a static H/K packet in response to a Dump H/K buffer command.

# MPS Level 4 Requirement Modifications (continued)

ETS

- **Based on the change noted on the previous slide, the following spacecraft simulation mode requirement has been removed:**
  - V2-32440-11 MPS shall provide for the storage of housekeeping telemetry to be used as playback data.
  - NOTE: The capability to store generated EDUs of housekeeping data and to transmit the files via KFTP are included in the MPS EDOS simulation mode as requirements V2-32430-04 and V2-32430-08, respectively.

- **The following "data conversion" requirements have been removed due to interface changes:**
  - V2-31130-02: MPS shall accept directives that control the editing, reporting, and conversion of an ASCII formatted Model Parameters file to a binary format of the Model file.
  - V2-31130-03: MPS shall accept directives that control the editing, reporting, and conversion of resident telemetry files into CCSDS packet formats.
  - V2-33200-01: MPS shall convert ASCII-formatted modeling files into a binary format which can be processed by Simulate S/C C&DH and EDOS Processing SWCI.

- **The following requirements have been removed due to lack of need:**
  - V2-31110-09 MPS shall build and forward simulation configuration commands that set packet intervals (sample rate) for all real-time APIDs generated by the AM-1 spacecraft.
  - V2-32120-06 MPS shall execute telemetry directives that set sample rates for real-time APIDs generated by the AM-1 spacecraft.

# MPS Status

ETS

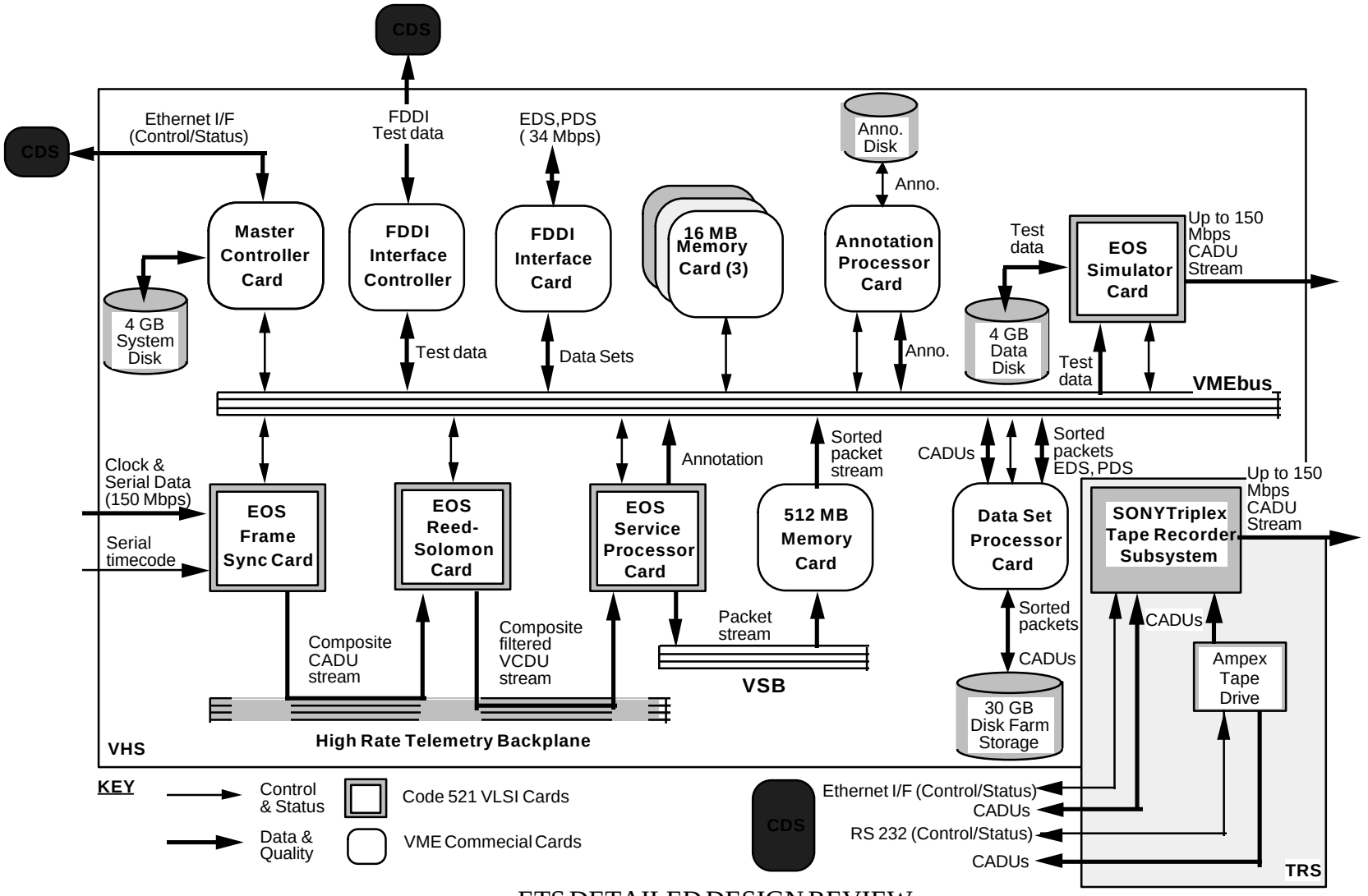
- **Status**
  - Received baseline software (TTTS R2.3) - 2/12/96
  - All CDR responses incorporated into MPS Detailed Design Specification - 2/16/96
  - Procured and configured MPS hardware and software components - 3/1/96
  - Initial unit testing of primary MPS command and telemetry functionality - 3/6/96
- **Data Needs**
  - Modeling information
  - PDB
  - Telemetry parameter initial values

# HRS Detailed Design Overview

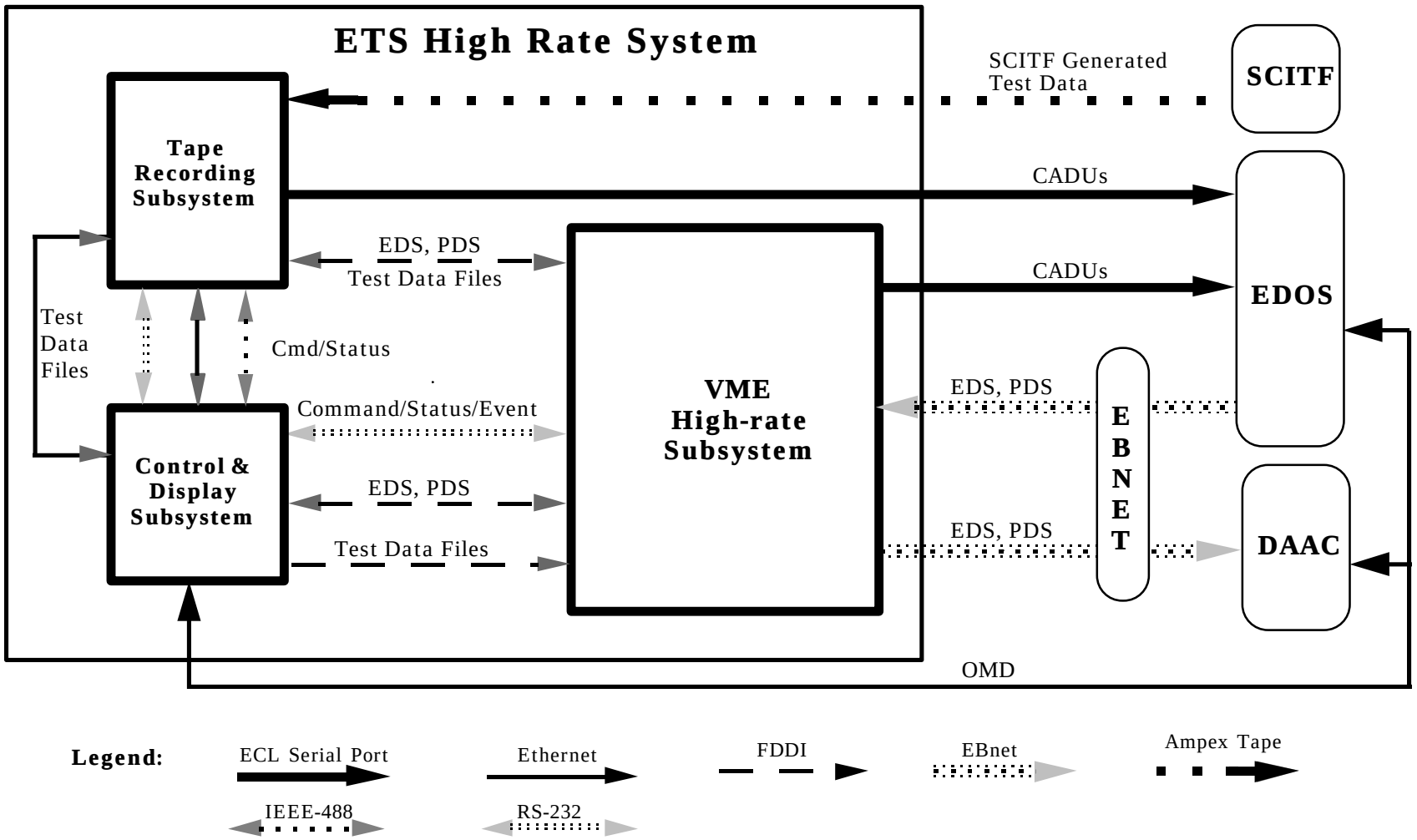
# Major HRS Functions

- Simulate TGT high rate return link by transmitting up to two 150 Mbps serial data streams.
- Simulate EDOS output by transferring data sets to a DAAC via EBnet at sustained data rates up to 34 Mbps.
- Simulate DAAC front end by capturing EDOS data sets via EBnet at sustained data rates up to 34 Mbps.
- Accept and playback SCITF test data on Ampex tapes.
- Process SCITF test data to generate CADU files, and EDOS-compatible EDS and PDS.
- Provide a GUI-based control environment that supports automated operations.

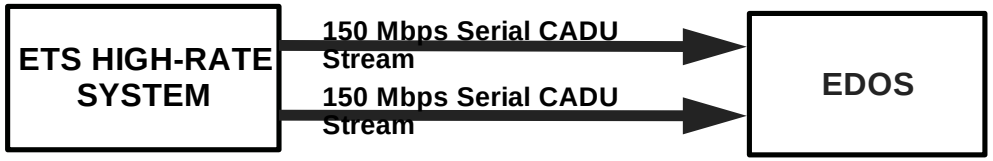
# System Design Block Diagram



# System Interface Diagram



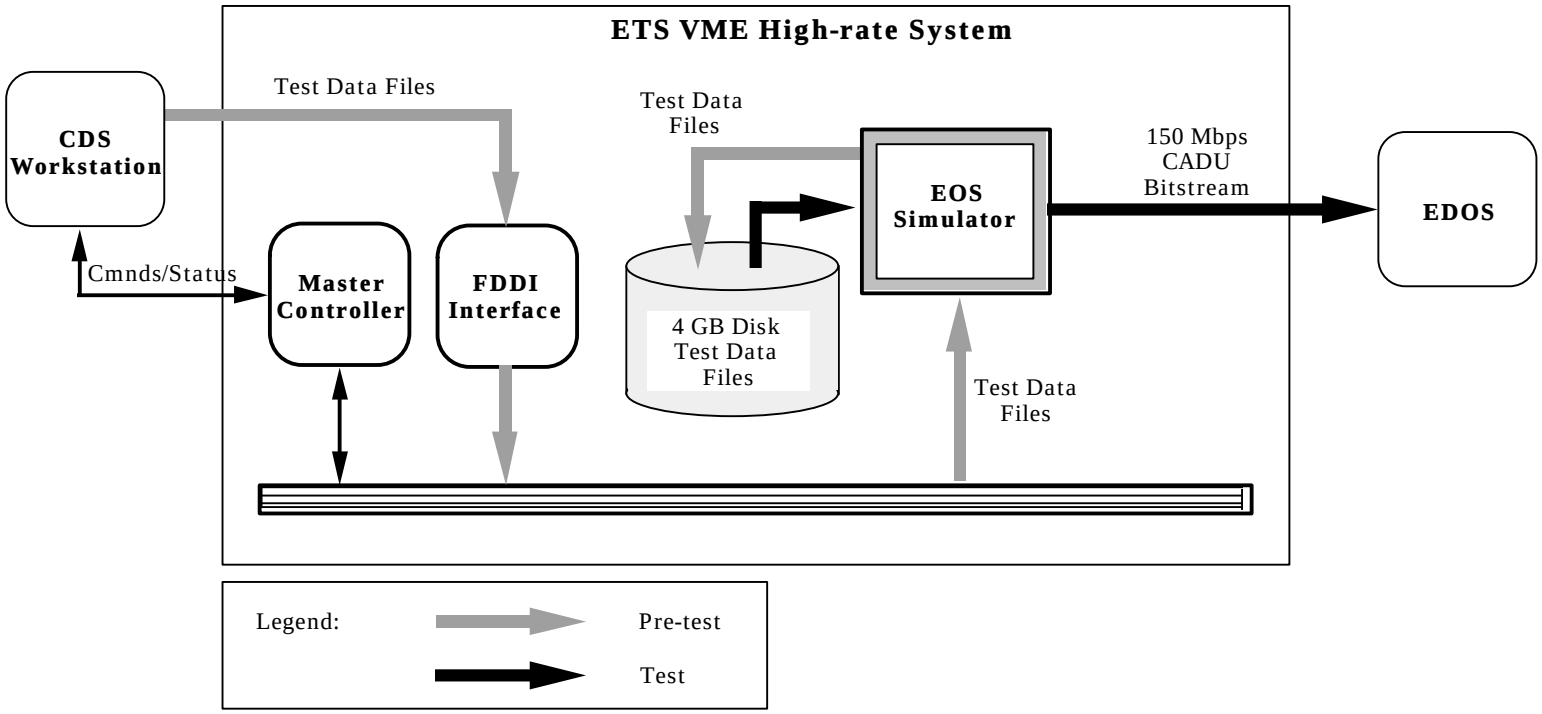
# Requirements for Simulating TGT Outputs



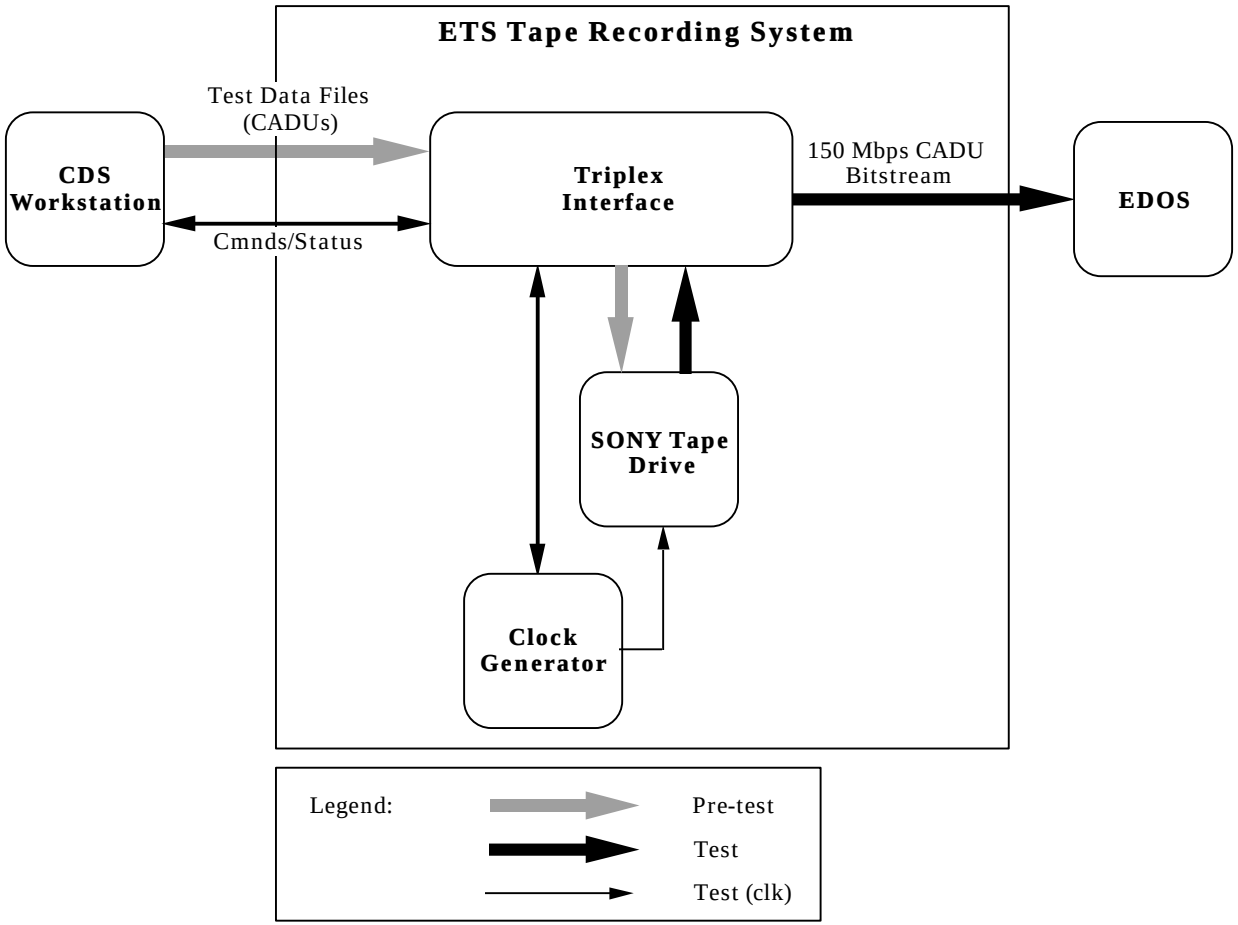

HRS APPLICATION 1: SIMULATING AM-1 SCIENCE RETURN LINK DATA

- **Two independent serial output channels, data rates up to 150 Mbps with a 1Kbps resolution.**
- **One channel outputs SCTGEN generated test data base set (up to 4 MB in size), with pre-defined updates at a maximum update rate of 30 Mbps.**
- **The other channel outputs a complete test data file, from SCITF or SCTGEN.**
- **Maximum simulated TSS of 25 minutes (25 Gbytes).**
- **Reed-Solomon encoding on-the-fly for interleave levels 1-4.**
- **Capability to insert slip errors, up to 3 bits at user specified location and direction.**

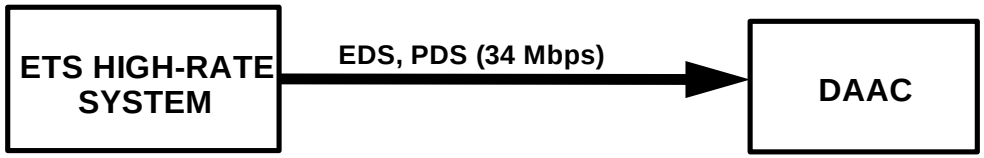
# Simulating TGT Output (1)



# Simulating TGT Output (2)



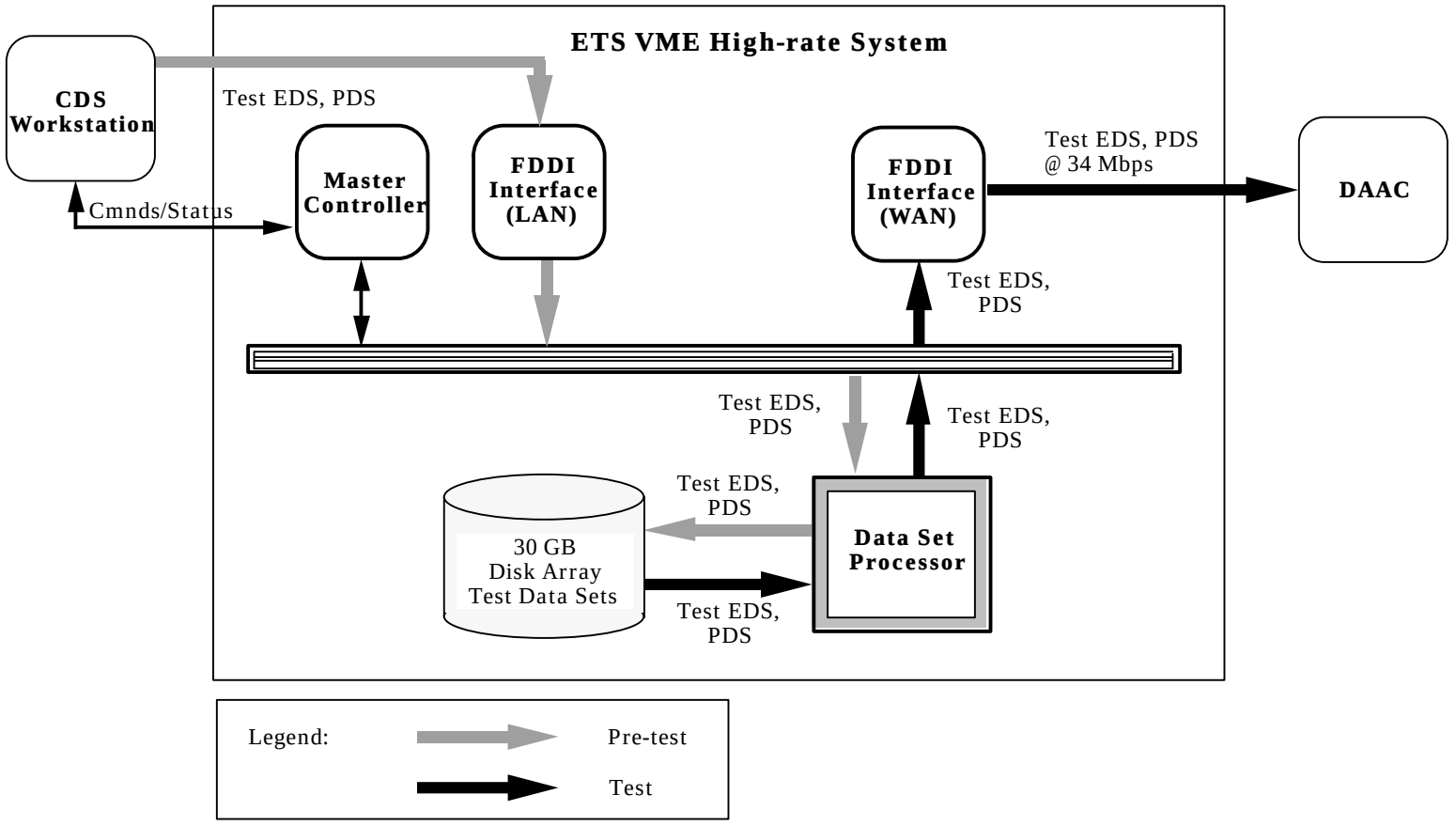
# Requirements for Simulating EDOS Output




HRS APPLICATION 2: SIMULATING EDOS OUTPUT TO TEST DAAC FRONT-END

- **Simulate EDOS data set output by transferring data sets to a DAAC via EBnet at data rates up to 34 Mbps.**
- **Support FTP/IP and TCP/IP protocols in Kerberos environment.**
- **Simulate data sets up to a maximum size of 25 GB, consisting of multiple files each no more than 2 GB in length.**
- **Data sets can be provided by the user, simulated by SCTGEN, or generated by VHS from SCITF test data.**
- **Provide data set information for delivery records to be handled by OMD Simulator.**
- **Provide capability to transfer multiple data set files automatically.**

# Simulating EDOS Output

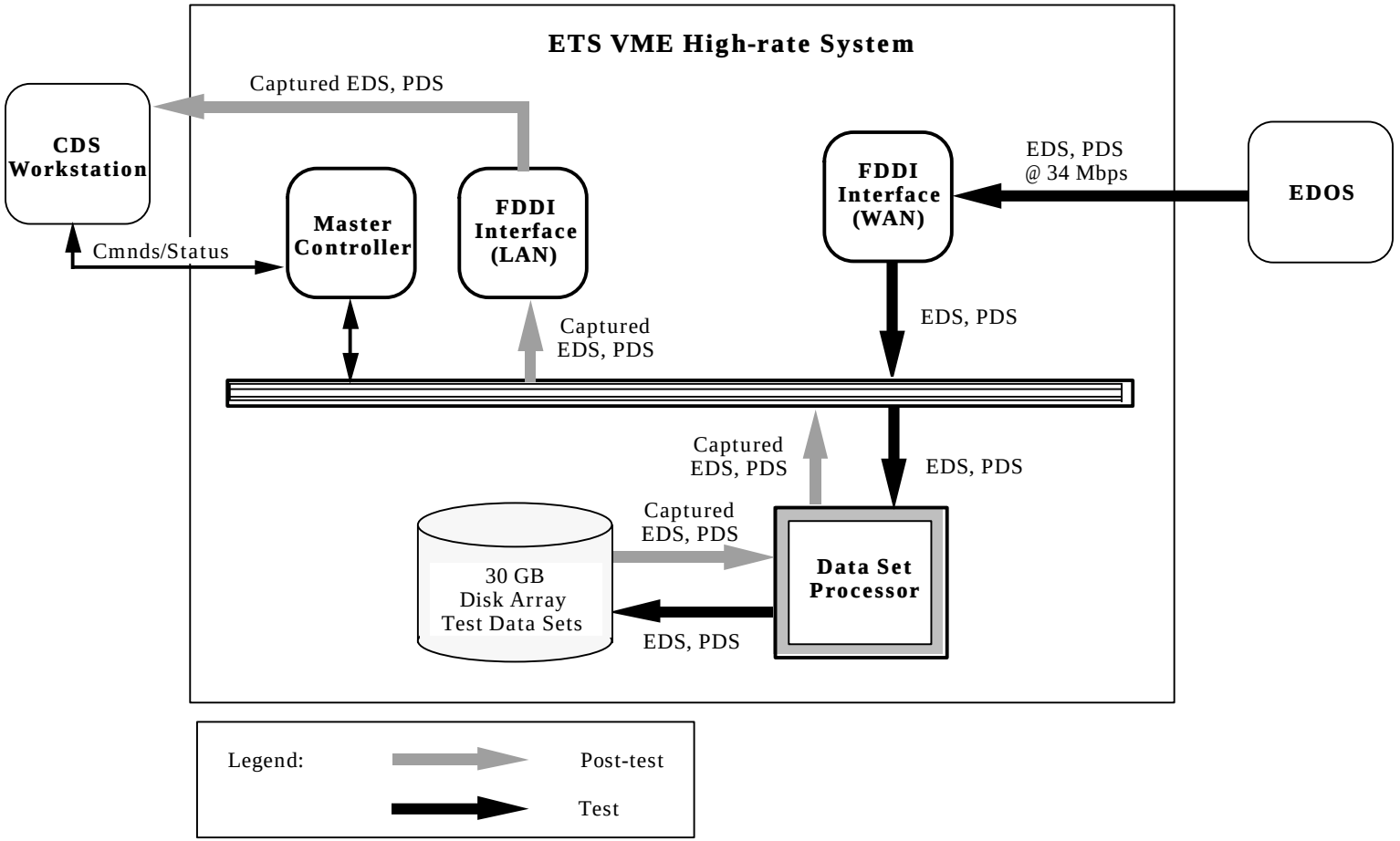


# Requirements for Simulating DAAC Front-End


HRS APPLICATION 3: SIMULATING DAAC FRONT-END TO TEST EDOS OUTPUT

- **Simulate DAAC front end by receiving and storing EDOS data sets via EBnet at data rates up to 34 Mbps.**
- **Support FTP/IP and TCP/IP protocols in Kerberos environment.**
- **Verification and analysis of captured data sets supported by CDS analysis tools.**
- **Reject incoming data sets when there is not enough space on VHS to store it.**

# Simulating DAAC Front-End



# Requirements for Reading and Transferring from SCITF-Generated Data Tapes

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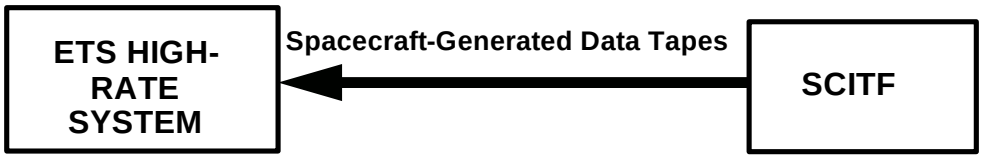
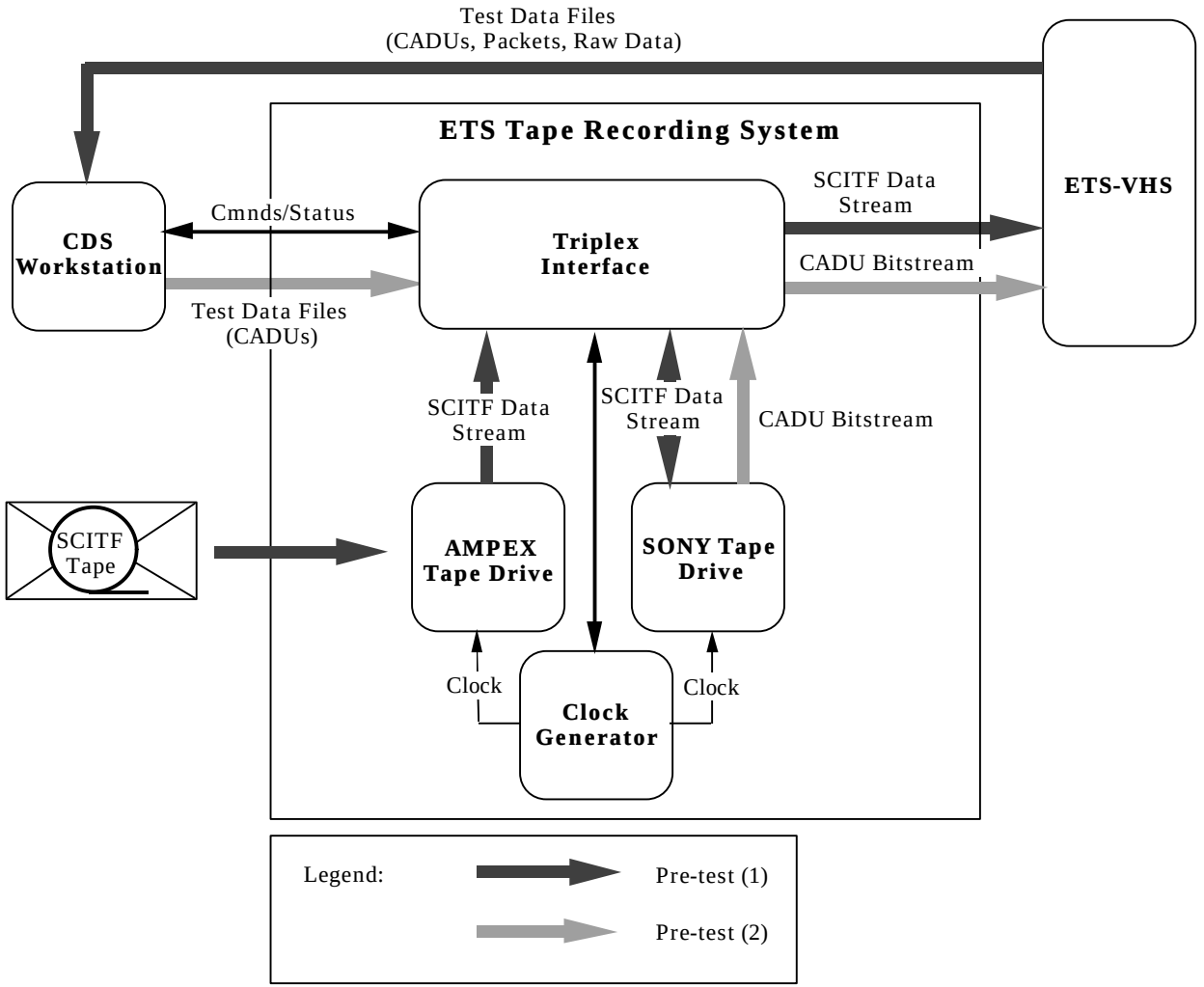


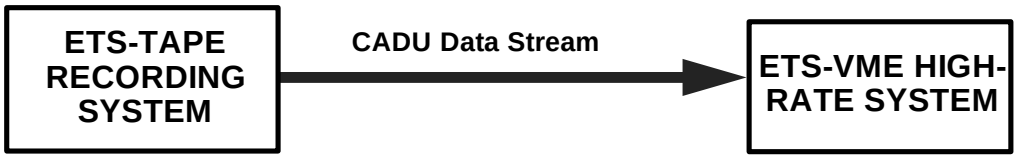

HRS APPLICATION 4: READING AND TRANSFERRING FROM SPACECRAFT-GENERATED DATA TAPES

- **Read and transfer SCITF-generated test data from Ampex tapes.**
- **Process SCITF-generated test data to generate test data files consisting of CADUs, packets, or raw sensor data.**

# Reading & Transferring from SCITF-Generated Data Tapes



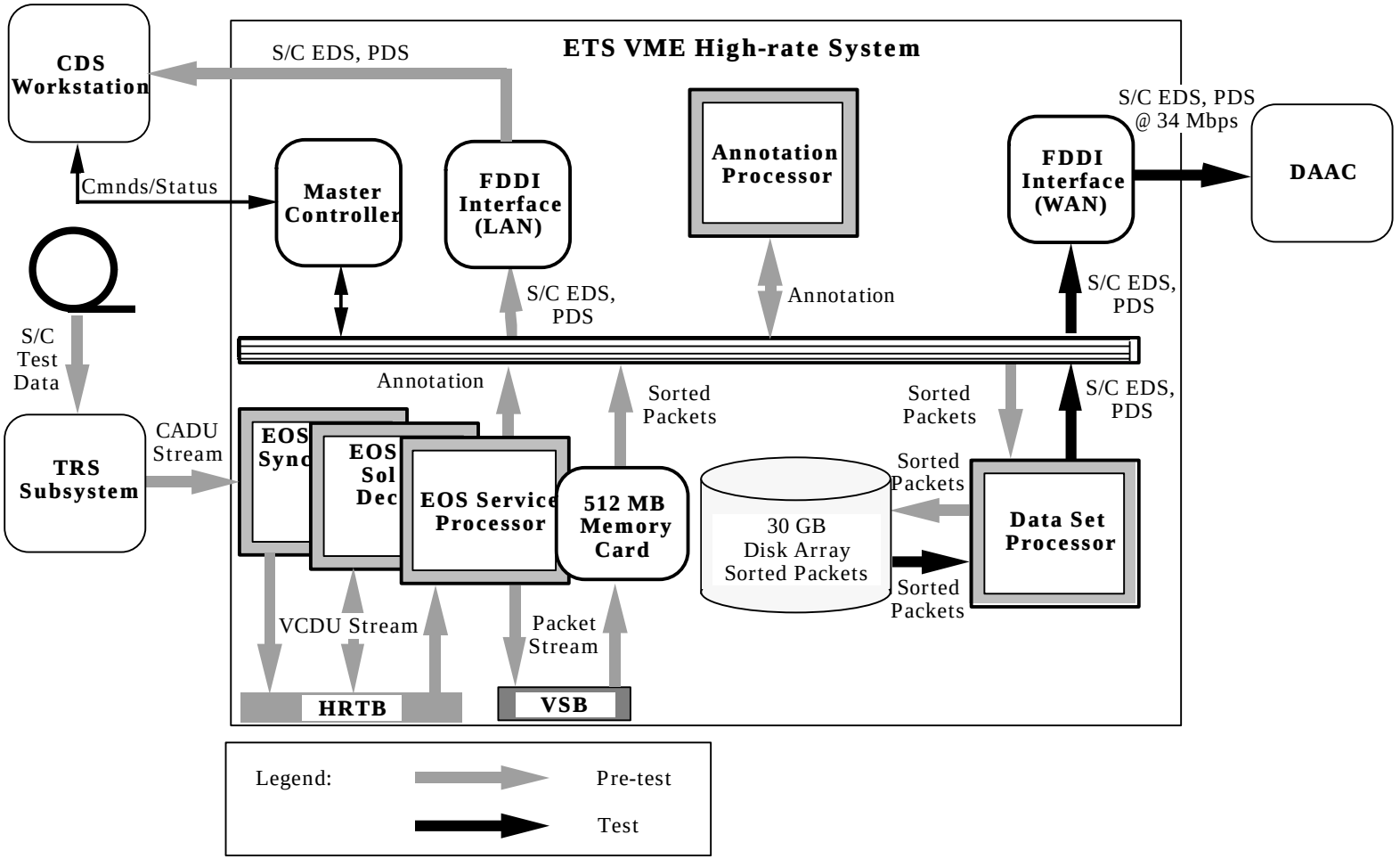
# Requirements for Processing SCITF-Generated Test Data




**HRS APPLICATION 5: PROVIDE CADU DATA TO VHS FOR DATA SET GENERATION**

- **Encapsulate and provide SCITF-generated test data in a CADU data stream for data set generation.**
- **Simulate the EDOS processing functions to generate a file of CCSDS Version 2 frames or Channel Access Data Units (CADUs).**
- **Simulate the EDOS processing functions to generate a stream of annotated packets or EDUs.**
- **Simulate the EDOS processing functions to generate Expedited Data Sets (EDSs) and Production Data Sets (PDSs).**

# Generating EDOS Data Sets from S/C Data



# Lines of Code

| Process Descriptions | Total Lines of Code | Percentage of Reuse |
|---|---|---|
| MEDS | 34,000 | ~100% |
| Master Controller | 7,500 | 95% |
| Data Set Processor | 4,300 | 60% |
| Annotation Processor | 5,000 | 85% |
| Tape Recording System | 15,000 | 0% |
| Frame Synchronizer | 4,000 | 95% |
| Service Processor | 18,000 | 75% |
| Simulator | 7,000 | 75% |
| Reed-Solomon Decoder | 10,070 | 100% |
| Telemetry Processing Control Environment | 79,000 | 95% |
| OMD Simulation | 5,000 | 0% |
| Utilities | 9,500 | 0% |

# ETS HRS Build Plan

| Build | Date | Functions | Hardware | Software |
|---|---|---|---|---|
| 1 & Demo. | 5/96 | •Create and store test data<br>•Transmit test data in CADUs at 150 Mbps<br>•Generate and store EDSs and PDSs<br>•Transmit EDSs and PDSs via EBnet at 34 Mbps<br>•Capture and store EDSs and PDSs at 34 Mbps<br>•Playback user-provided data from an Ampex tape drive<br>•Generate EDSs and PDSs from user-provided test data<br>•Generate CADU files from user-provided test data<br>•Partial WS interface (control and status)<br>•Receive and transmit OMD and display OMD event | Rack with all cards, which may include prototypes. An Ampex tape drive w/ WS IF. | Build 1 |
| 2 | 9/96 | In addition to functions in Build 1:<br>•Verify EDSs and PDSs generated by EDOS<br>•Generate the 2nd 150 Mbps CADU stream via the TRS<br>•Full WS interface (OMD, report generation, DVT and DCT)<br>•Transfer user-provided test data from Ampex to SONY drive | Replace prototypes with production cards. Upgrade the rack | Build 2 |

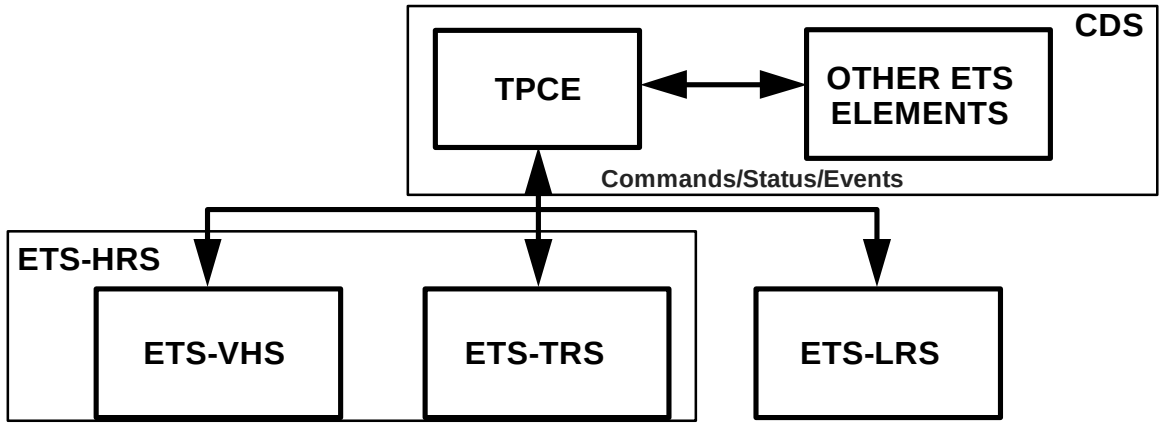
# Status

ETS

- **Completed Draft HRS Detailed Design Specifications document. This will be revised and re-distributed when all comments are received.**
- **Ampex evaluation model is being tested concurrent to the Ampex procurement.**
- **Reshape impacts have been minimized, and ETS-HRS will provide a serial CADU data stream to EDOS for recording on to Ampex DIS 160i tape media.**
- **ETS-HRS Build 1 and a limited-capabilities demonstration is scheduled for May 8, 1996.**

# Telemetry Process and Control Environment (TPCE)

# Major TPCE Requirements




- Provides the capability for status gathering, display, external serving.
- Provides expert system control for automated commanding.
- Provides manual commanding of VME systems.
- Provides the capability of Unix-launching of other tools in ETS.
- Provides data distribution management for outgoing data from HRS.
- Provides CODA information via external status serving.
- Provides the capability to log VME & TPCE events into log file.

# Goals, Objectives & Approach

- **Reduce operations costs by building autonomous control and monitoring environment.**
- **Build reusable software components which provide these common capabilities.**
- **Completely build an object-oriented design:**
  - Client/Server, multi-process architecture.
  - Component designs based on KISS principle.
  - Hierarchic design structure of atomic- to process-level objects.
  - Loose coupling.
- **Implement design in C++:**
  - Every component is a C++ class.
- **Utilize an Event-driven runtime structure:**
  - All system actions are based on queued events - user input, timers, socket I/O.
- **Make the components reusable through:**
  - Formal certification of component design and implementation through peer review.
  - Coding and documentation style guides.
  - On-line documentation of components including examples and test programs.
- **Make the components portable through use of standards:**
  - UNIX operating system, POSIX compliance.
  - Graphic user interface based on the X Window System and the Open Software Foundation's Motif style.

# Status

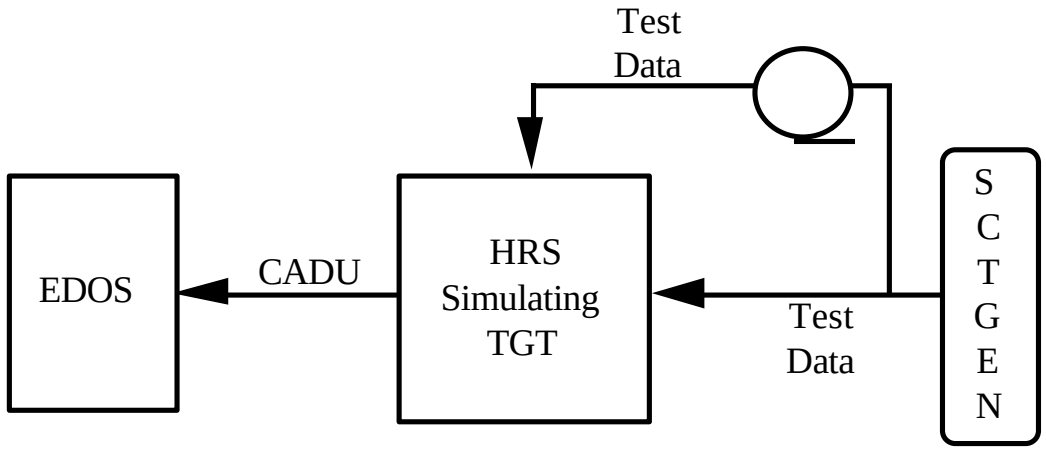
- **The TPCE system used in the ETS project will be mostly reused from previous TPCE projects.**
  - 96% to 97% software reused
- **No new capabilities are needed for TPCE -- by simply making modifications to the current capabilities ETS needs will be met.**
- **The changes needed are:**
  - Catalog, Command, and Status support for each subsystem in the ETS VME systems - largest area of changes.
  - Changes to User-Interface (UI) module to meet project guidelines and requirements - minor changes.
  - Configuring data distribution management for HRS - minor to major changes depending on VME software capabilities.
- **TPCE will be demonstrated both in the ETS-HRS and ETS-LRS demonstration to be held on 5/8/96 and 5/29/96 respectively.**

# Simulated CCSDS Telemetry Generator (SCTGEN)

# Major SCTGEN Functions

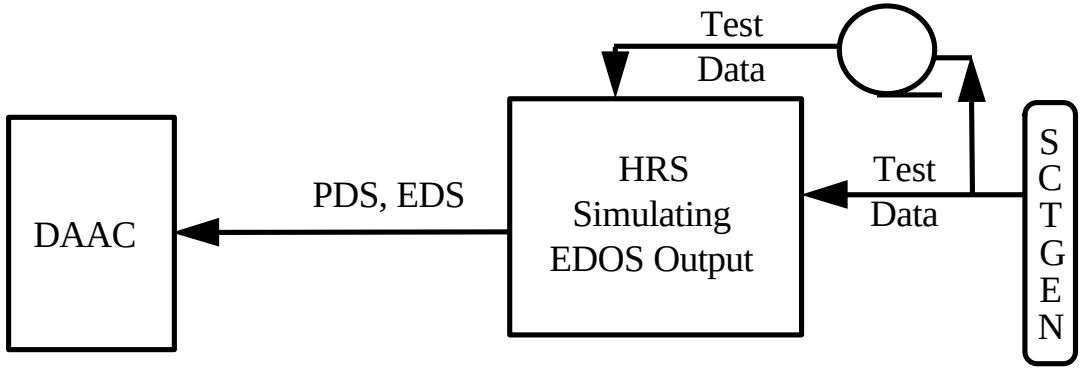
- **Generate CCSDS return link data consisting of:**
  - CCSDS Version 2 Coded Virtual Channel Access Data Units (CVCDUs) and Channel Access Data Units (CADUs).
  - CCSDS Version 1 Packets.
- **Generate EDOS data products consisting of:**
  - EDOS Data Units (EDUs), consisting of CCSDS Version 1 Packets with EDOS Service Headers.
  - Expedited Data Sets (EDS) which consist of time ordered packets sorted by APID on a per session basis.
  - Production Data Sets (PDSs), which consist of time ordered, overlap deleted, quality annotated packets sorted by APID on a user-selected time period.
- **Simulate errors in the generated or user-provided CCSDS return link data or EDOS data products.**
- **Generate an expected results summary of the generated test data and the inserted errors.**
- **Store all generated data on to disk and tape storage media.**

# Requirements to Support ETS Test Configuration 1



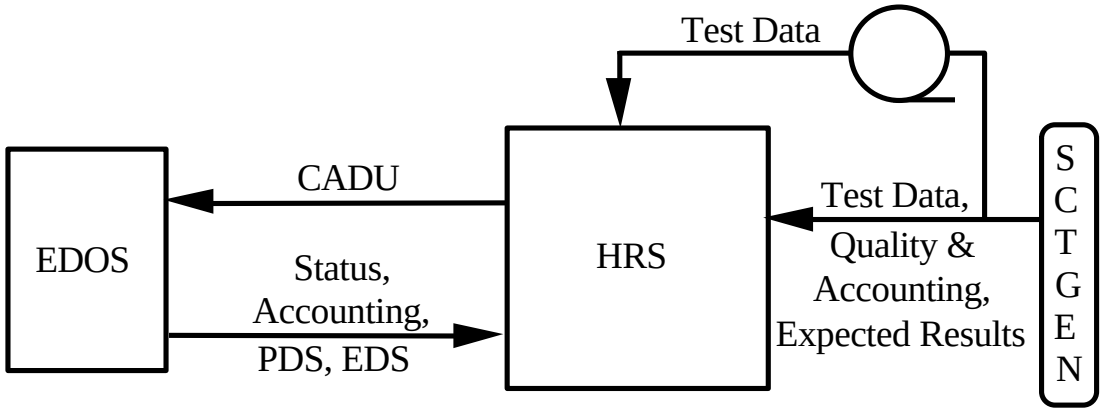

- SCTGEN will create test data to be subsequently loaded into the VHS component of the HRS to be sent out as a serial CADU stream at a sustained data rate of 150 Mbps.
- SCTGEN will create test data which will be stored directly on tape media to be subsequently sent out by the TRS component of the HRS as a serial CADU stream at a sustained data rate of 150 Mbps.

# Requirements to Support ETS Test Configuration 2




- SCTGEN will generate test data that will be fed into the VHS component of the HRS for data set processing and transfer to the DAACs via EBnet.
- SCTGEN will generate test data that will be stored on tape media in the TRS for subsequent input to the VHS component of the HRS for data set processing and transfer to the DAACs via EBnet.
- SCTGEN will generate data sets that will be stored on the HRS for subsequent transfer to the DAACs via EBnet.

# Requirements to Support ETS Test Configuration 3




- SCTGEN will generate test data that will be transmitted to EDOS for data set processing and data set transfer to the DAACs.
- SCTGEN will generate data quality and accounting information which can be used to check received data sets from EDOS at the DAACs (simulated by ETS).
- SCTGEN will produce a set of expected results to be used for comparison in the post-test phase.

# Lines of Code

| Software Process Descriptions | Lines of Code |
|---|---|
| Main ETS Layer Functions | ~2,000 |
| CCSDS Layer Functions | ~6,000 |
| CORE Functions | ~10,000 |

Note: All of the core functions and most of the CCSDS layer functions have been completed.

# Build Plan

| Build | Date | Functions |
|---|---|---|
| Prototype | 11/95 | •Basic EOS AM-1 return link data simulation (packets, CADUs, data multiplexing)<br>•Raw error insertion, generation of gaps |
| 1 | 4/96 | In addition to functions in Prototype:<br>•Formatted error insertion, complex data simulation to support HRS, RS encoding<br>•Data streams containing gaps, scrambled time order, errors, etc.<br>•Simulation of quicklook flag<br>•Telecommand packets, frames, CLTU simulation<br>•Generation of expected results<br>•GUI functionality<br>•Data verification<br>•EDOS Data Products simulation (EDS, PDS, EDUs, Rate-buffered Files) |
| 2 | 7/96 | In addition to functions in Build 1 and the Prototype:<br>•More GUI functionality<br>•Crash Recovery Capability<br>•Report Generation |

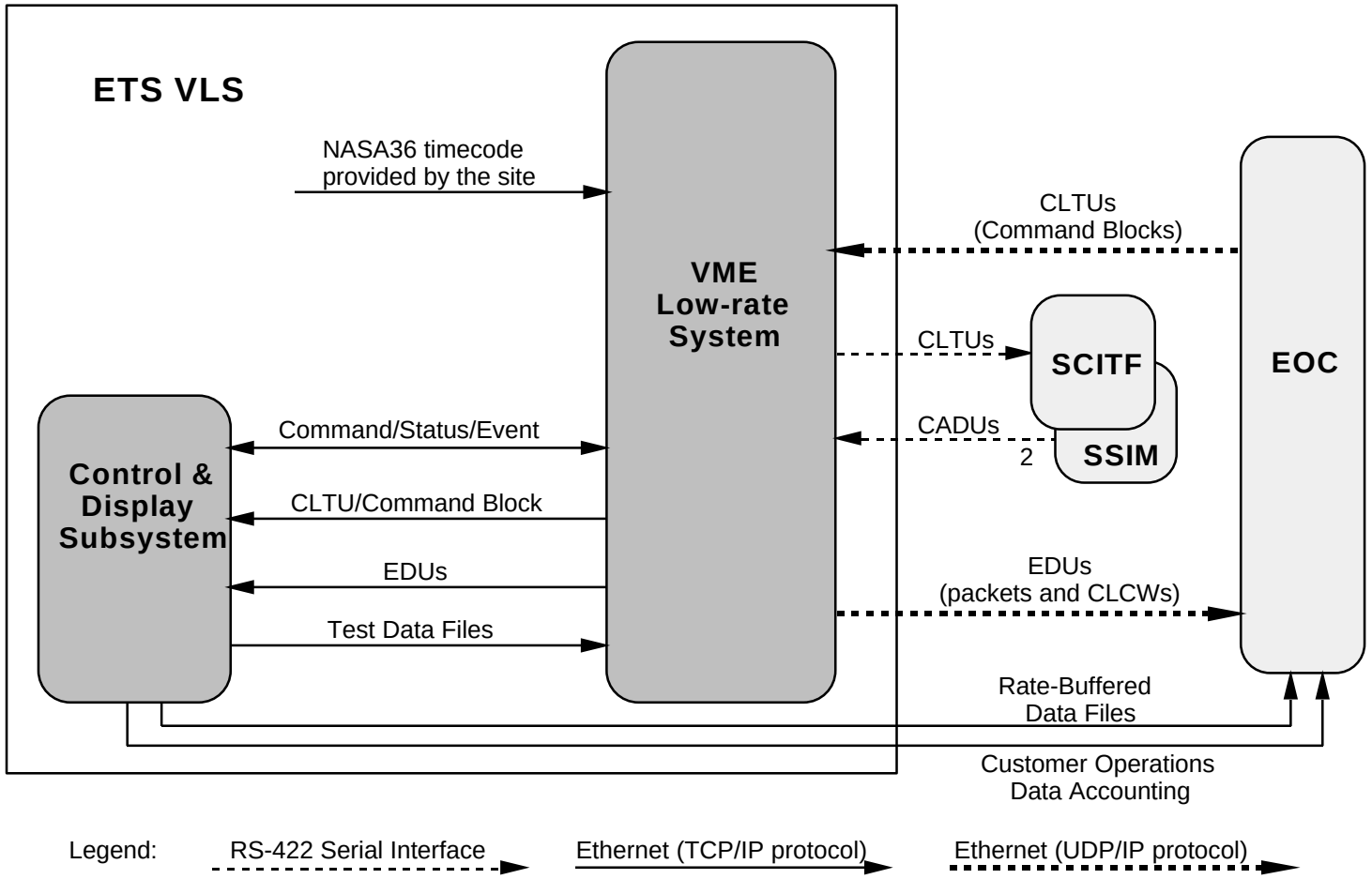
*Note: The SCTGEN capabilities will be demonstrated with the LRS and HRS Build 1 demonstrations.

# Status

- **Completed Draft SCTGEN Detailed Design Specifications document. This will be revised and re-distributed when all comments are received.**
- **The demonstration version of SCTGEN was completed in November 1995.**
- **Return-link and forward-link data generation capabilities are being used for internal testing of the Code 521 system elements.**
- **SCTGEN will be demonstrated both in the ETS-HRS and ETS-LRS demonstrations scheduled for 5/8/96 and 5/29/96 respectively.**

# LRS Detailed Design Overview

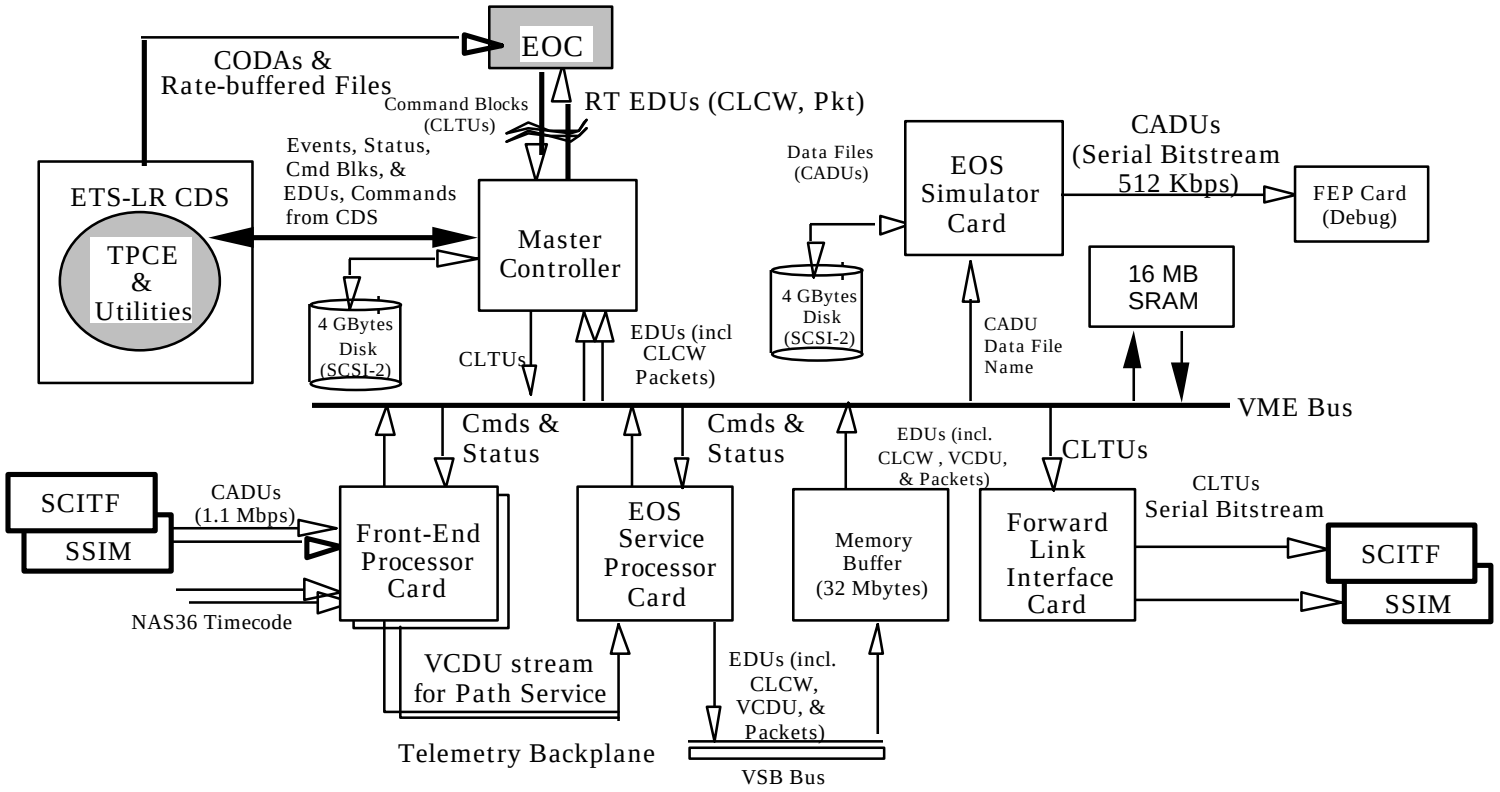
# ETS-LRS Block Diagram



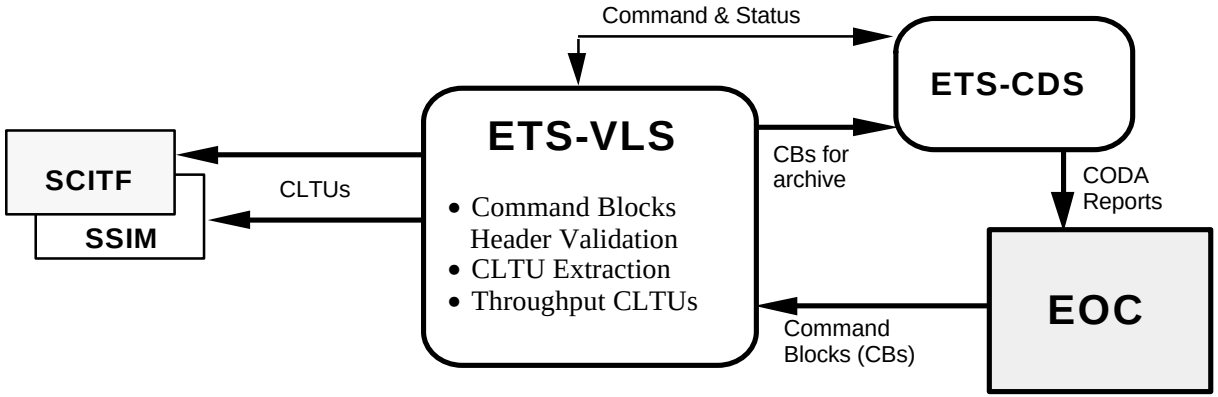
# Functional Requirements

- **Simulate EDOS forward link processing functions by receiving Command Data Blocks, checking EDOS ground message headers, extracting forward link data, and forwarding it to SCITF/SSIM**
- **Transmit forward link data to SCITF/SSIM at 125 bps, 1 Kbps, 2Kbps, or 10 Kbps**
- **Simulate EDOS low rate return link processing functions by receiving and processing up to two S-band serial data streams**
- **Perform return-link processing at data rates up to 1 Mbps**
  - Process up to 8 spacecraft IDs (SCID)
  - Process up to 31 Virtual Channels
  - Process up to 521 Application Process IDs (APID)
  - Process up to 521 sources
- **Transmit return link data as EDUs and rate buffered data files**
- **Provide a GUI-based control environment that supports automated operations**

# System Interfaces

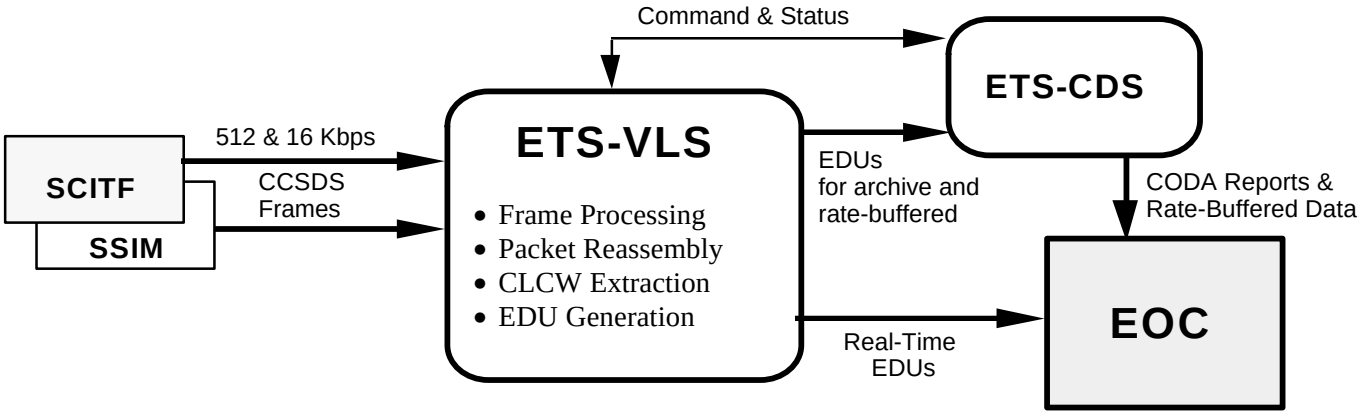


# Uplink Processing Scenario



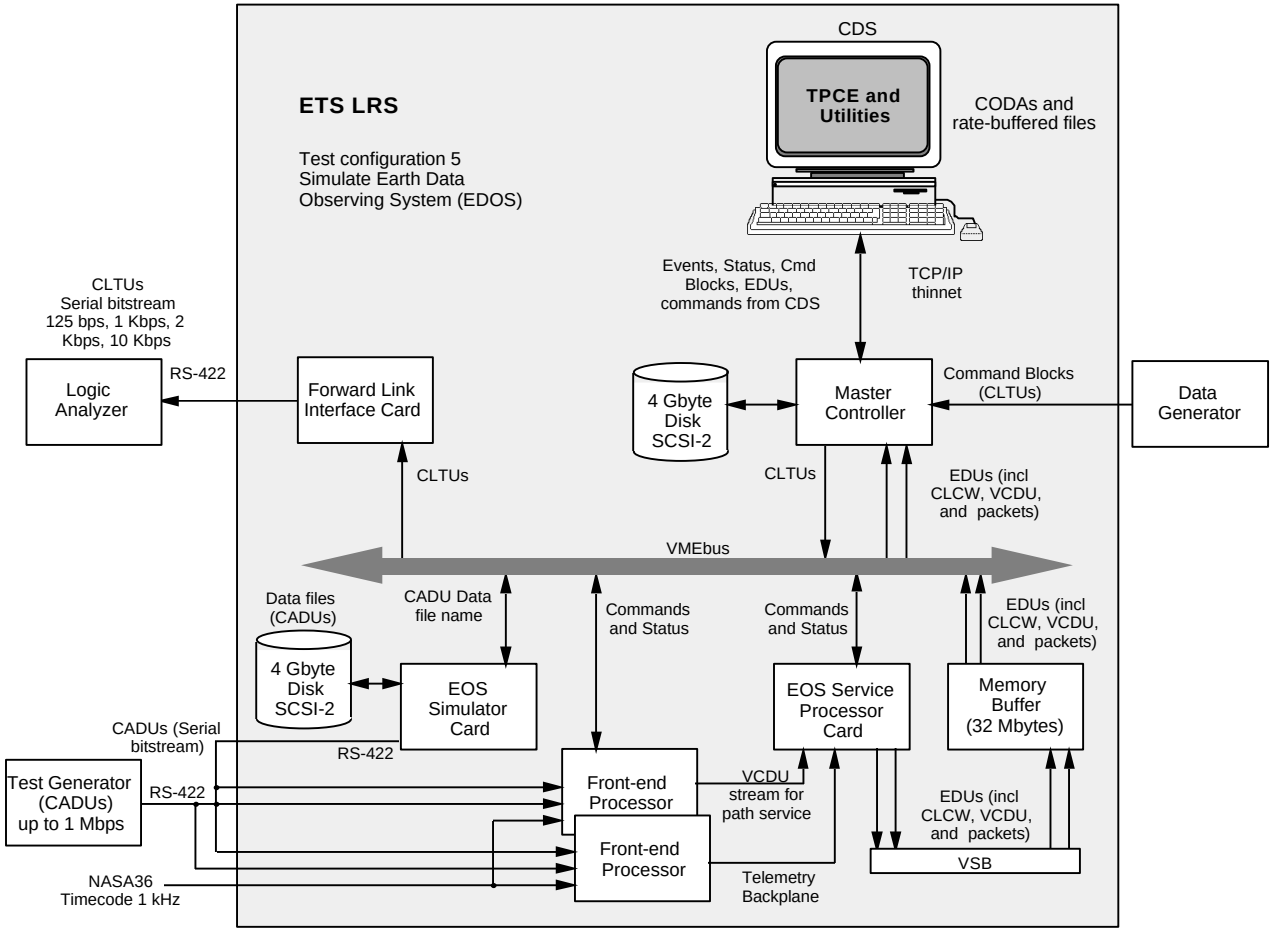

- **Receive Command Blocks from EOC**
  - Validate command block header
  - Deposit valid CLTUs in mailbox
  - Send command blocks to CDS for archiving
- **Forward CLTUs to SCITF and SSIM**
  - Retrieve valid CLTUs from mailbox
  - Output clock and data CLTUs to SCITF and SSIM at a selectable rate

# Return Link Processing Scenario




- **Frame Level Processing**
  - Process two serial input streams (512 Kbps maximum rate for one channel and 16 Kbps for other)
  - Time stamp and perform Reed-Solomon decoding and correction to each frame
- **Packet Level Processing**
  - Reassemble source packets by any combination of SCID, VCID, and APID
  - Generate EDUs and send to EOC or CDS for archiving
  - Send rate-buffered data and CODA reports to EOC

# System Test Configuration



# Lines of Source Code

| Process Descriptions | Lines of Code | Percentage of Reuse |
|---|---|---|
| MEDS | 7000 | 99 % |
| Command Block Processing | 500 | 0 % |
| EDU Generation | 250 | 0 % |
| Gateway | 2500 | 90 % |
| Front End Processor | 7200 | 5% |
| Service Processor | 13000 | 83 % |
| Forward Link Interface | 6000 | 90% |
| Simulator | 1900 | 75 % |
| Telemetry Processing Control Environment | 78000 | 96 % |
| OMD Simulation | 5000 | 95 % |
| Utilities | 6700 | 30 % |

# Build Plan

| | | |
|---|---|---|
| BUILD 1 | 1) Capture and process command blocks from EOC<br>2) Transmit CLTU to SCITF/SSIM<br>3) Capture and process CADU from SCITF/SSIM<br>4) Extract packets and transmit them as EDU to EOC<br>5) Extract CLCWs and transmit them as EDU to EOC<br>6) Partial WS interface (control & status)<br>7) Receive and transmit OMD<br>8) Display OMD event | A chassis with all cards, some of which may be prototype. |
| BUILD 2 | 1) Process the second CADU stream<br>2) Generate and transmit rate buffered data files<br>3) Generate and transmit CODA reports<br>4) Full WS interface (CODA, OMD generation) | Replace prototype cards, if any, with production ones. Upgrade the chassis. |

# Status

- **FLIC can be set up to output at 10 Kbps. All lower rates will be automatically supported.**
- **If output rate is initially set low (e.g., 125 bps), manual upload of catalog will be required to output a faster rate (e.g., 10 Kbps). Request for command rate change will be initiated from EOC via a voice loop.**
- **Completed revision of LRS Detailed Design Specification**
- **First demonstration of LRS will be on May 29, 1996**

# Development and Testing Environment

# Development and Testing Environment

| Development and Test Phase | HRS & LRS | MPS |
|---|---|---|
| Prior to Build 1 | Code 520 - Data Systems Technology Division (DSTD) lab, Building 23; CSC ETS lab | CSC ETS lab and Code 515 -SOC, Building 25 |
| Build 1 Demonstration | DSTD Lab | SOC |
| Prior to Build 2 | SOC | SOC |
| System and Integration Testing | SOC<br>(Time share LRS with EOC) | SOC |
| Acceptance Testing | Preliminary: SOC<br>Final: HRS at EDOS<br>LRS at EOC<br>(Time share LRS with EOC) | Preliminary: SOC<br>Final: EOC, EDOS |

- **Code 515/Simulations Operations Center (SOC) will be site for ETS integration and testing activities**
  - Provides suite of test tools and test equipment to support integration and testing activities
  - Provides data lines to support early, informal checkout of systems with EOC
  - Provides early opportunity for testers to gain system familiarization and to develop test procedures on a non-interference basis with developers

# Test Tools Overview

| Tool | Source | Purpose | Application |
|---|---|---|---|
| **CCSDS Test Tool (CTEST)** | SOC baseline | Generate commands from predefined files and receive commands in serial stream<br><br>Receive, process, and display CCSDS telemetry stream | MPS spacecraft command generation<br><br>Receive MPS processed telemetry |
| **QC Replay** | COTS | Record tester activity for future replay and verification | Execute system tests and regression tests for verifying future builds and IDR resolution |
| **Network Analysis Tool (NAT)** | SOC baseline | Transmit, receive, store, and display network protocol data formats (UDP/IP, TCP/IP) | MPS and LRS spacecraft command generation and telemetry receipt |
| **Data Quality Monitor (DQM)** | SOC baseline | Real-time display of data quality counts | Display quality counts for CADU processing |

# Integration Test Approach

# System and Integration Test Approach

ETS

- **S&IT uses SSDM methodology and building block approach**
- **Independent CSC test team wrote Integration Test Plan/Procedures and System Test Plan/Procedures documents**
  - Final plan contents distributed on 3/5/96
  - Formal test procedures contents under configuration control and delivered at Build Readiness Review (BRR)
- **Test reports prepared after execution of tests**
  - Quick look reports provide status of testing on a weekly basis, or as required by ATR and ESDIS project
  - Final test reports document successfully completed and anomalous test results
  - Red-lined test procedures approved by Product Assurance personnel are provided as part of formal test record

# Discrepancy Report Tracking

ETS

- **Internal Discrepancy Reports (IDRs) generated by independent CSC team during Integration and System Testing**
- **Unresolved IDRs converted to Discrepancy Reports (DRs) at Acceptance Testing**
  - Additional problems identified in the delivered software during acceptance testing documented as DRs
  - DRs resolved by ETS developers during acceptance test phase
  - DRs resolved by ETS maintenance organization after ETS delivered for operational use
- **Comprehensive Discrepancy System (CDS) recommended as problem reporting system**
  - Cross-platform tool currently in use by other Code 510 testing organizations for acceptance and mission readiness team testing
  - Requires connection to the CNE, an IP address, and installation of supporting and client software to enter and view reports
  - Designated user controls IDR disposition and status through CDS interface
  - Requires CDS administrator setup, and some reinterpretation of concept of operations as defined in Release 4.0 User's Guide
  - Problem output existing after completion of Integration and System Testing can be input into DRTT for tracking during ETS operational phase

# Integration Testing Status

ETS

- **Status**
  - Defined test cases detailing test methods and success criteria
    - Allocated requirements to specific test cases within the test sets (Appendix A in ITPP)
    - Allocated test sets to builds
  - Identified test tools, stubs and drivers needed or requiring modification
  - Beginning refinement of test procedures, creation of test data, and identification of needed inputs
  - Beginning detailed definition of test environment needs
    - Network connectivity
    - Platforms for test tools and drivers

# CI Interfaces

| System or Subsystem | S/W or H/W CI | Interfacing CIs | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Menu Controller | OMDSIM | CDS Utilities | TPCE | SCTGEN | CDS H/W | VHS | TRS | VLS | MPS | MPS Utilities |
| CDS | Menu Controller | | X | X | X | X | X | X | | X | X | |
| | CDS-hosted OMDSIM | | | | | | X | X | | X | | |
| | CDS Utilities | X | | | X | | X | X | | X | | |
| | TPCE | | | | | | X | X | X | X | | |
| | SCTGEN | | | | | | X | X | X | X | | |
| | CDS H/W | | | | | | | X | | X | | |
| HRS | VHS | | | | | X | | | X | | | X |
| | TRS | | | | | | | X | | | | |
| LRS | VLS | | | X | X | X | | X | X | | | |
| MPS | MPS | | X | | | | | X | | | | X |
| | MPS=hosted OMDSIM | | | | | | | | | | X | |
| | MPS Utilities | | | | | | | | | | X | |

# Integration Test Set Mapping to Builds

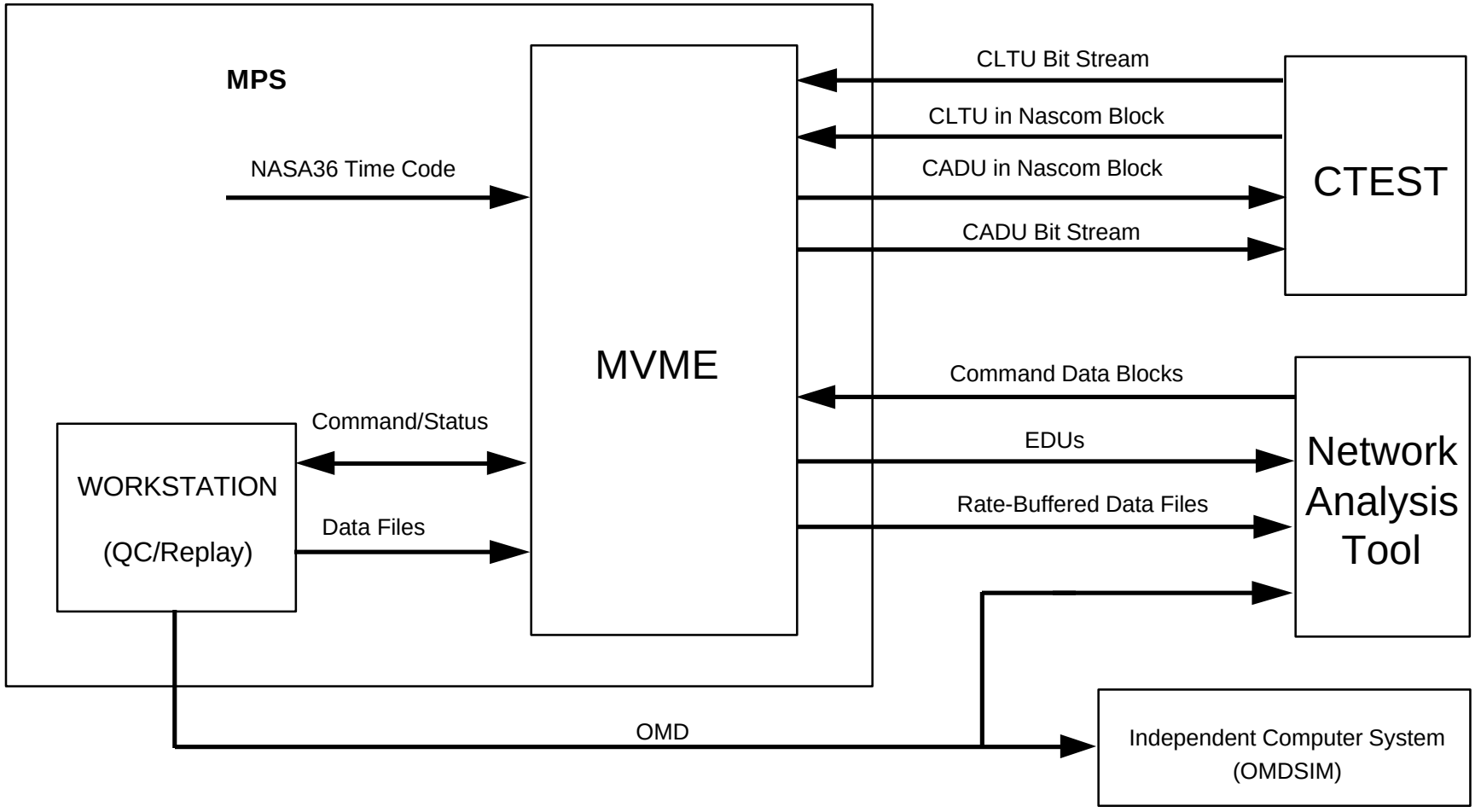
| | Test Set | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Build** | **MCINIT** | **HRSCOMM** | **HRSDATA** | **HRSEDOS** | **VHSTRS** | **SCTDATA** | **TPCEACT** | **TPCECFG** | **TPCEJOUR** | **TPCESTAT** | **TPCEHRS** | **TPCELRS** | **LRSCOMM** | **LRSCADU** | **LRSCLTU** | **LSREDU** | **MPSHK** | **MPSPDB** | **OMDCODA** | **OMDSTOR** |
| **HRS 1** | X | X | | | | | X | X | X | X | X | | | | | | | | | X |
| **HRS 2** | | | X | X | X | X | | | | | | | | | | | | | | |
| **LRS 1** | X | | | | | | | | | | | | X | P | | P | | | | X |
| **LRS 2** | | | | | | | X | X | X | X | | X | | X | X | X | | | X | |
| **MPS 1** | X | | | | | | | | | | | | | | | | | X | | P |
| **MPS 2** | | | | | | | | | | | | | | | | | X | | X | X |

X - requirements allocated to test set are verified for specified build

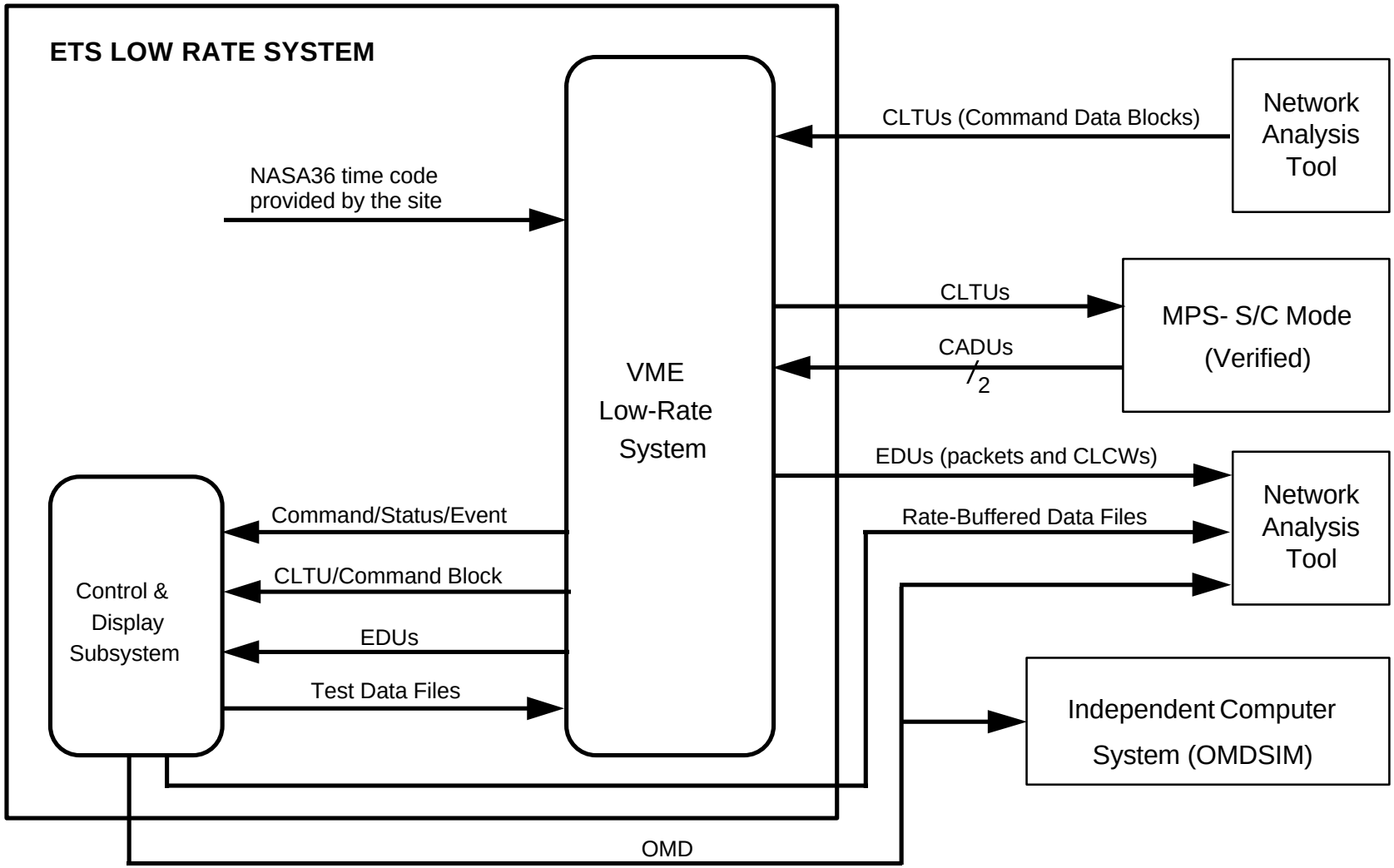
P - partial verification of requirements allocated to test set

# System Test Approach

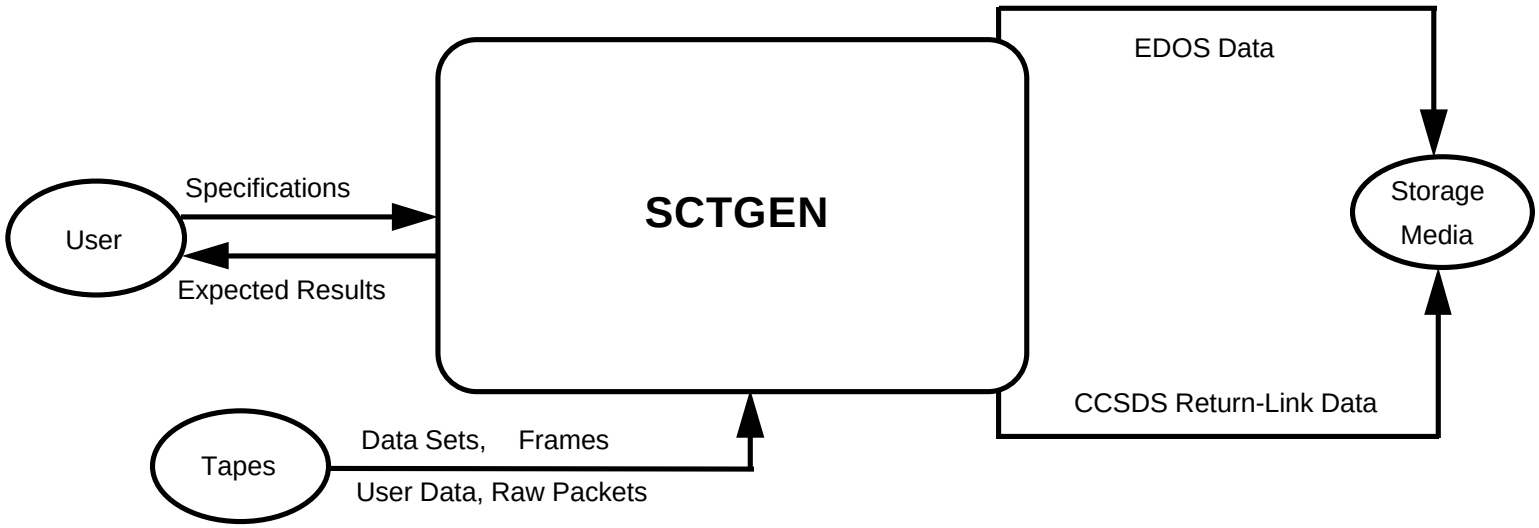
# MPS System Test Configuration



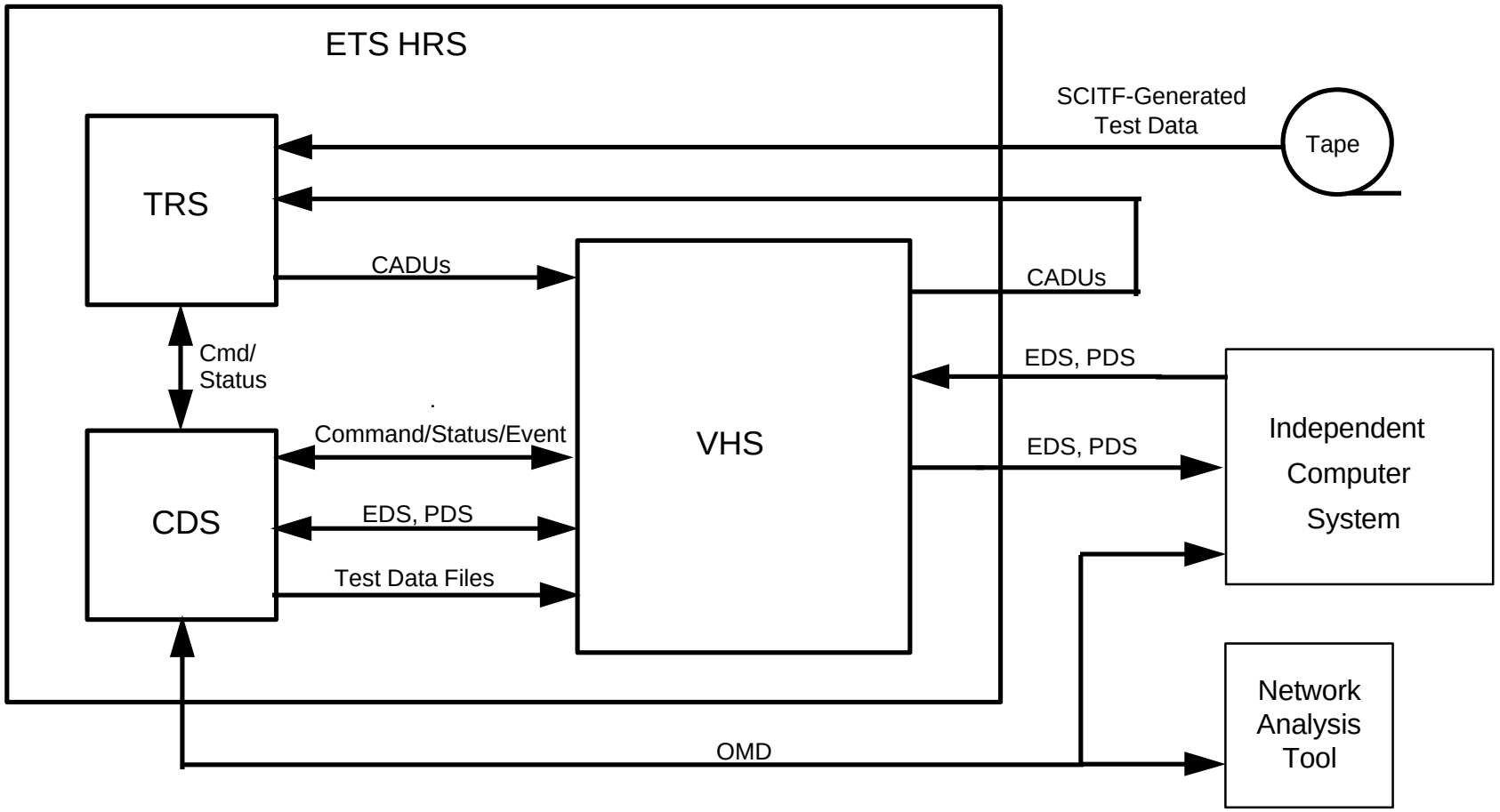
# LRS System Test Configuration



# SCTGEN System Test Configuration



# HRS System Test Configuration



# System Testing Status

ETS

- **Status**
  - Attended ETS development meetings
  - Toured Code 520 Data Systems Technology Division (DSTD) Lab
  - Met with Code 520 system test engineer
  - Developed ETS system test plan
  - Continuing to write system test procedures
    - Code 520's internal system testing used as a foundation for LRS and HRS system testing
  - Working with Acceptance Test Team
    - QC/Replay test tool
    - Insight into integration and system testing

# Acceptance Test Approach

# Efforts to Date

ETS

- **Conducted a Requirements Study**
  - Delivered formal requirements study document (October, 1995)
- **Reviewed Design Documentation**
  - Comments forwarded to ETS development team (Feb, 1996 for LRS/MPS and Mar, 1996 for HRS/SCTGEN)
- **Generated Acceptance Test Plan**
  - Draft version delivered for review (Feb, 1996)

# Future Efforts

ETS

- **Complete Acceptance Test Plan**
- **Attend demonstrations of system**
- **Generate Acceptance Test Procedures**
- **Observe Integration and System Testing**
- **Review User's Manuals**
- **Conduct Acceptance Testing**

# Acceptance Test Planning

ETS

- Group requirements by functionality
- Develop test sets and test cases
- Create operational scenarios
- Attend demonstrations
- Review ETS project related documentation
- Gather and verify test data

# Acceptance Testing

ETS

- **Conduct acceptance testing within operational environment**
- **Perform testing through several methods including: functional, performance regression, and operational scenarios**
- **Generate Discrepancy Reports (as needed)**

# Acceptance Testing

ETS

- **Verify and validate Discrepancy Reports**
- **Automated Testing**
  - Record/Playback of test cases/Comparison of results
- **Generate final verification test report and recommendation for acceptance of system**
- **Support Discrepancy Report Status meetings**
- **Collect Test Metrics**

# Training Approach

# Efforts to Date

ETS

- **Generated Training Management Plan**
  - Identifies subject areas for training and resources required to conduct training
  - Proposes suggested training schedule
  - Contains a training item checklist
  - Draft version delivered for review (Jan, 1996)

# Future Efforts

ETS

- **Complete Training Management Plan**
- **Attend demonstrations**
- **Identify entities that require training**
- **Identify areas of expertise**
- **Review User's Manuals**
- **Develop training packages**
- **Conduct training**

# Training

ETS

- **Lectures**
  - Overview of system
- **Demos**
  - Exchange of technical information (being conducted as early as April)
- **Hands-On**
  - Unix functions
  - SCTGEN functions
    - User procedures/Scenarios
  - HRS functions
    - User procedures/Scenarios
  - LRS functions
    - User procedures/Scenarios
  - MPS functions
    - User procedures/Scenarios

# Training

ETS

- **Collect Training Metrics**
  - Training Feedback form
  - Evaluate the effectiveness of training
  - Improve training (real-time)
  - Forward feedback forms to the customer

# Transition To Operations

# Transition to Operations

ETS

- **O&M Team needs to be established**
- **Training to be provided by AlliedSignal Technical Services Corporation (ATSC) System Integration and Verification (SIV) Team**
- **All system components to be included with the delivery will be provided in the configuration specified and in the required format, medium, and quantity.**
- **Deficiencies**
  - All known anomalies and deficiencies will be identified
- **Documents**
  - All delivered documents will be complete and accurately reflect the system as delivered (design document, interface specifications, users guides, and other descriptive materials)
- **Management**
  - Report will be prepared that addresses development, implementation, integration, and testing of the delivered system.
- **Transition of hardware and software**
  - Operations and maintenance responsibility will transfer from ETS Development Team to O&M Team
- **Post-delivery**
  - Responsibilities for ETS activities transfer to the ESDIS Project
  - ETS Development Team will provide support for resolution of hardware/software anomalies through FY97

# Issues

# Issues

ETS

- **Competition for ETS Resources and Services During August - November 1996 Timeframe**
  - Engineering Models (Development/Testing have not been completed)
    - MPS 8/1/96
    - LRS 9/3/96
  - System Testing (August - September 1996)
  - Acceptance Testing (October - November 1996)
  - MPS, LRS, HRS Final Delivery (December 1996)
  - Priority:
    - System Testing/Acceptance Testing / Problem Resolution
    - Training
    - EGS Support
    - Other Users

# Issues

ETS

- **Location of ETS HRS and MPS to support EDOS interface testing**
  - Floor space availability
  - ECL cable for serial data transfer limited to about 25 feet
    - Affects location of ETS tape recorder system to transfer data to EDOS tapes
    - Affects location of ETS HRS to transmit data at 45 Mbps to EDOS@GSFC(Reshape rate)
- **Designation of ETS operations and maintenance personnel and responsibility**
  - Operational procedures need to be developed
  - Familiarization activities can begin right now

# RID/Comment Process

# RID/Comment Process

ETS

- **Two forms for noting discrepancies/comments/clarifications related to this review presentation and the materials handed out**
  - Code 510 Review Item Discrepancy (RID) Form
  - Comment/Clarification Form - Use this form instead of the RID form to submit informal comments to the ETS Project, or to request clarification on a point made at the ETS Design Review
  - Hardcopies of both forms provided as handouts at this review
- **All forms due in by March 15, 1996**
- **Please submit forms by mail or hand carry to:**

Willie Fuller
NASA/GSFC Code 515.1
GSFC Building 3, Room 129
(301)286-6912

# Acronyms

ETS

- AOS — Advanced Orbiting Systems
- APID — application process identifier
- AM-1 — morning equatorial crossing spacecraft series
- ASCII — American Standard Computer Inflation Exchange
- ATR — Associate Technical Representative
- ATS — absolute time sequence
- BER — bit error rate
- bps — bits per second
- BRR — build readiness review
- C&DH — command and data handling
- C&S — control and status
- CADU — channel access data unit
- CB — command block
- CCB — Configuration Control Board
- CCR — configuration change request
- CCSDS — Consultative Committee for Space Data Systems
- CDS — Control and Display Subsystem
- CDS — Comprehensive Discrepancy System
- CGEN — Command Generator
- CI — configuration item
- CMD — command
- cntrl — control
- CODA — customer operations data accounting
- COP — command operations procedure
- COTS — commercial off-the-shelf
- CPU — Central Processing Unit
- CR — construction record
- CSC — Computer Sciences Corporation
- CVCDU — coded virtual channel data unit
- DAAC — Distributed Active Archive Center
- DCT — Data Comparison Tool
- DD — data dictionary
- DDS — detailed design specification
- DFCD — data format control document
- DFD — data flow diagram
- diag — diagnostic
- DPR — data processing rate
- DRAM — Dynamic Random Access Memory
- DR — Discrepancy Report
- DS — data set

# Acronyms (continued)

ETS

- **DSAT** — Data Set Assembly Table
- **DSI** — delivered source instruction
- **DSN** — Deep Space Network
- **DSTD** — Data Systems Technology Division
- **DVT** — Data Verification Tool
- **EBnet** — EOSDIS Backbone network
- **EDOS** — EOS Data and Operations System
- **EDS** — expedited data set
- **EDU** — EDOS data unit
- **EGS** — EOS Ground System
- **EOC** — EOS Operations Center
- **EOS** — Earth Observing System
- **EOSDIS** — Earth Observing System Data and Information System
- **ESDIS** — Earth Science Data and Information System
- **ESH** — EOS Service Header
- **ETS** — EOSDIS Test System
- **F&PR** — Functional and Performance Requirements
- **FDDI** — Fiber Distributed Data Interface
- **FEP** — front end processor
- **FOT** — Flight Operations Team
- **FPGA** — field programmable logic array
- **FTP** — file transfer protocol
- **GaAs** — Gallium Arsenide
- **GMT** — Greenwich mean time
- **GN** — ground network
- **GSFC** — Goddard Space Flight Center
- **GUI** — graphical user interface
- **H/K** — house keeping
- **HR** — high rate
- **HRTB** — High Rate Telemetry Backplane
- **HRS** — High-Rate System
- **H&S** — health and safety
- **HW** — hardware
- **ID** — identification
- **IP** — internet protocol
- **ICD** — interface control document
- **ICWG** — interface control working group
- **IDR** — Internal Discrepancy Reports
- **IRD** — Interface Requirements Document
- **ISO** — International Standards Organization

# Acronyms (continued)

ETS

- **IV&V** — independent verification and validation
- **kbps** — kilobits (thousands of bits) per second
- **KFTP** — Kerberos File Transfer Protocol
- **LAN** — local area network
- **LR** — low rate
- **LRS** — Low-Rate System
- **Mbps** — megabits (millions of bits) per second
- **MDM** — multiplexer-demultiplexer
- **MEDS** — Modular Environment for Data Systems
- **MET** — mission elapsed time
- **MOU** — Memorandum of Understanding
- **MPS** — Multimode Portable Simulator
- **MRBD** — managed rate buffered data
- **MSB** — Microelectronic Systems Branch
- **MUX** — multiplexer
- **NASA** — National Aeronautics and Space Administration
- **Nascom** — NASA Communications
- **OMD** — operations management data
- **OMDSIM** — OMD Simulator
- **OMT** — Object Modeling Technique
- **OSF** — Open Software Foundation
- **PDB** — project database
- **PDS** — production data set
- **pkts** — packets
- **PN** — pseudorandom noise
- **Pspec** — process specification
- **PSS** — portable spacecraft simulator
- **QA** — Quality Assurance
- **QC** — Quality Center
- **RAM** — Random Access Memory
- **RID** — review item disposition
- **RE** — record express
- **RTS** — relative time sequence
- **S&IT** — system and integration test
- **SCTGEN** — Simulated CCSDS Telemetry Generator
- **S/C** — spacecraft
- **SCID** — spacecraft identifier
- **SCITF** — Spacecraft Integration and Test Facility

# Acronyms (continued)

ETS

| | |
|---|---|
| SCSI | small computer serial interface |
| SDR | system design review |
| SDU | service data unit |
| SITPP | System and Integration Test Plan/Procedures |
| SIV | System Integration and Verification |
| SN | Space Network |
| SOC | Simulations Operations Center |
| SRAM | Static Random Access Memory |
| SRS | system requirements specification |
| SSIM | spacecraft simulator |
| SSR | solid state recorder |
| StP | Software through Pictures |
| SW | software |
| SWCI | software configuration item |
| TBC | to be confirmed |
| TBD | to be determined |
| TBS | to be specified |
| TC | telecommand |
| TCP | transmission control protocol |
| TDRS | Tracking and Data Relay Satellite |
| TDRSS | Tracking and Data Relay Satellite System |
| TFS | Telemetry Frame Synchronization |
| TGT | TDRSS Ground Terminal |
| TLM | telemetry |
| TPCE | telemetry processing control environment |
| TRS | Tape Recorder Subsystem |
| TSS | TDRSS Service Session |
| TTL | transistor-transistor logic |
| UDP | user datagram protocol |
| UIF | user interface |
| VC | virtual channel |
| VCDU | virtual channel data unit |
| VHS | VME High-Rate Subsystem |
| VLS | VME Low-Rate Subsystem |
| VLSI | very large scale integration |
| VME | versa module eurocard |
| VSB | VME subsystem bus |
| WAN | wide area network |
| WSC | White Sands Complex |
| XTE | X-Ray Timing Explorer |
| XTTS | XTE Test and Training Simulator |